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Draft Final

Technical Impracticability Evaluation, Operable Unit 1, Quanta Resources Superfund Site, Edgewater, N.J.

Submitted to

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Prepared by

CH2MHILL
25 New Chardon Street
Suite 300
Boston, MA 02114

400458

Executive Summary

This draft final technical impracticability (TI) evaluation has been prepared to assess the potential for restoring groundwater at the Quanta Resources Superfund Site Operable Unit (OU) 1 in Edgewater, New Jersey (the Site) as a potable water source. The restoration would occur by achieving certain applicable or relevant and appropriate requirements (ARARs). A Remedial Investigation has been completed for the Site, and remedial alternatives have been evaluated as part of a Feasibility Study (FS). Alternatives were developed and evaluated in the FS to meet site Remedial Action Objectives (RAOs) for groundwater. The RAOs for remediation of groundwater at the site include the following:

- Prevent or minimize potential exposure by contact, ingestion, or inhalation/vapor intrusion that presents unacceptable risk; and
- Prevent migration and preferential flow of constituents of concern (COCs) to OU2 at levels resulting in risk above acceptable levels to human health or ecological receptors.

However, it is further specified in the National Contingency Plan (NCP) that "EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of ground water to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction". (NCP 300.430(a)(1)(iii)(F)).

The objective of this evaluation is to determine whether it is technically practicable, from an engineering perspective, to restore groundwater at the Site, within a reasonable timeframe.

Evaluation of Restoration Potential

Groundwater restoration potential at OU1 is significantly influenced by contaminant-related factors and hydrogeologic factors that limit the effectiveness of subsurface remediation. Other site-specific factors may also limit the effectiveness of remediation and (or) limit the applicability of certain technologies, or render complete restoration futile. This evaluation is consistent with the Examples of Factors Affecting Ground-Water Restoration provided in Figure 1 of EPA's *Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration* (EPA, 1993).

Factors such as the volume and duration of the release of site-related constituents have been considered in evaluating the potential for groundwater restoration at the Site. The chemical properties of these constituents, and the volume and depth of contaminated media were also considered. Site-specific hydrogeologic characteristics including the relative complexity of the geology, the nature of unconsolidated sediments, the degree of heterogeneity, and the presence of low hydraulic conductivity materials at the Site were assessed as they relate to groundwater restoration potential. Finally, factors related to the highly developed urban setting were also included in this assessment.

In summary, the evaluation of the factors identified above as it relates to the potential for groundwater restoration at the Site includes the following categories of factors.

Contaminant-related factors such as:

- The widespread presence of dense non–aqueous phase liquid (DNAPL) and recalcitrant DNAPL-related constituents.
- The long history of industrial use and associated releases at the Site.
- The volume and depth of contaminated media.
- The presence of arsenic in soil and groundwater, and the co-location of arsenic and DNAPL.

Hydrogeologic factors such as:

- The complex geology consisting of interbedded and undulating layers of sands, silts and clays with discontinuous peat deposits.
- Heterogeneous soil conditions and the presence of low permeability materials such as silts and clays.

Site-setting factors such as:

- The highly urbanized environment with significant surficial and subsurface infrastructure.

In addition, the presence of off-site sources and regional characteristics would render any restoration within OU1 futile. These sources would recontaminate the area and continue to render groundwater unusable as a potable source for reasons beyond the scope of the Quanta Resources Superfund Site. Further, conventional water resource planning practices render impossible the potential for the potable use of groundwater in the area. Such factors that have been considered at the Site include the saline content of the groundwater, given its proximity to the Hudson River, as well as drinking water well construction requirements.

A significant RAO for groundwater at the Site is to prevent migration of COCs from OU1 to the Hudson River (OU2) at levels resulting in risk above acceptable levels to human health or ecological receptors.. Given the additional non-aqueous phase liquid (NAPL) and NAPL-related constituents present in the deeper sediments of OU2, and the inevitable recontamination of groundwater as it moves through these sources, the elimination of the relatively small and indistinguishable mass of dissolved impacts coming from OU1 via groundwater will not add any significant incremental risk benefit to the resource. The OU2 Remedial Investigation/Feasibility Study (RI/FS) will evaluate remedial alternatives for addressing free-phase NAPL and NAPL-related constituents in sediments. However, the conditions are similar to OU1, where there are areas of free-phase NAPL and then extensive zones of more diffuse NAPL, making restoration impracticable even in the river sediments.

The findings of this evaluation reveal that it is technically impracticable to restore groundwater at the Site. Groundwater restoration cannot be achieved with the available means given the contaminant-related, site-specific, and site setting factors that are present at the Site.

It is feasible, as described in the Draft Final FS Report, to implement a remedy at the site that is protective of human health and the environment and achieves the RAOs for groundwater. The remedial alternatives in the Draft Final FS protect human health and the environment, maintain that protection over time, and are consistent in defining and addressing risk at the site.

This evaluation documents the conditions that make it impracticable, from an engineering perspective, to achieve specific ARARs within a reasonable timeframe and also presents an alternative remedial strategy that will protect human health and the environment.

Evaluation of Comprehensive Remediation

Fifteen (15) source areas at the Site have been identified and grouped. Soils between and adjacent to these 15 source areas also contain discontinuous NAPL and NAPL constituents as well as polycyclic aromatic hydrocarbons (PAHs) and metals related to historic fill which also represent sources to groundwater. Feasible technologies available to address source areas have been evaluated through the FS process. The remedial alternatives assembled in the Draft Final FS Report[1] use varying combinations of technologies to address principal threat source material and dissolved-phase COCs by eliminating exposure pathways, thereby controlling potential risk to human health and the environment.

However, based on the FS evaluation, the alternatives presented are not capable of achieving ARARs for groundwater. Therefore, as part of this TI evaluation, the feasible technologies identified in the FS were used to develop a comprehensive remedial approach that would involve the treatment or removal of all 15 key source areas as well as the interstitial source materials across the entire footprint of OU1. The development of this approach allowed for an assessment of its implementability from an engineering perspective as well as its likely success as a means to restore groundwater at the Site.

Due to the Site-specific contaminant and hydrologic factors as well as the highly urbanized environment, the implementation of the comprehensive remedial approach at the Site would not result in the restoration of groundwater. Additional institutional controls would be required in order to minimize potential risk to human health and the environment and achieve the RAOs for groundwater. Furthermore, the comprehensive treatment or removal of all source material within OU1 was determined to be impracticable because of the site-setting, administrative challenges, detrimental impact on the community during remediation, and cost. Since no appreciable long-term improvement in groundwater quality is expected by removing or treating source areas and residual contamination and there would be no measurable risk benefit to the adjacent surface water resource, the approximately $400 and $900 million required to remove or treat all source material within OU1 would be impracticable, ineffective, and cost prohibitive.

Given the impracticability of achieving ARARs, an alternative remedial strategy is necessary to ensure protection of human health and the environment in lieu of restoring groundwater.

[1] CH2M HILL. 2010. Draft Final Feasibility Study Report, Quanta Resources Superfund Site, Operable Unit 1, July.

Alternative Remedial Strategy

EPA's TI guidance requires the development of an alternative remedial strategy that considers exposure control, source control, and aqueous plume remediation in light of site-specific conditions. An alternative remedial approach has been developed in consideration of the potential for exposure to groundwater and the means available with which to control it, an assessment of the relative benefits to groundwater from addressing all sources, as well as the relative benefits and likelihood of remediating the aqueous plume. This alternative is protective of human health and the environment and is consistent with the RAOs that were developed during the FS process to achieve protection of human health and the environment. The two RAOs for groundwater are as follows:

- Prevent/minimize potential exposure by contact, ingestion, inhalation/vapor intrusion that presents unacceptable risk
- Prevent migration and preferential flow of COCs to OU2 (the Hudson River) at levels resulting in risk above acceptable levels to human health or ecological receptors

Alternatives were developed and evaluated in the FS to meet site RAOs. Of the alternatives developed, the alternative that is best-suited to achieve RAOs is Alternative 4a, NAPL and Arsenic In Situ Solidification/Stabilization. The complete development, evaluation, and comparative analysis of the FS alternatives is presented in the Draft Final FS Report.

The major components of Alternative 4a that will significantly reduce the volume of source material that is contributing to COCs in groundwater include:

- Tar boils and accessible NAPL in NZ-1, NZ-2, a portion of NZ-3, NZ-5 are solidified/stabilized in situ.
- All defined arsenic areas[2] are solidified/stabilized in situ.
- If treatability testing were to indicate that the in situ stabilization of arsenic is not feasible for the HCAA, it is assumed that hydraulic containment of the groundwater in the HCAA would be implemented as a contingency process option.
- A subaqueous reactive barrier (SRB) would be installed in OU2 to mitigate the potential for any COCs that remain in OU1 groundwater to discharge to surface water, if necessary.

A complete evaluation of Alternative 4a against the nine NCP evaluation criteria is included in the Draft Final FS Report. The proposed remedial strategy prevents unacceptable human health and ecological risk by preventing or minimizing exposure pathways through treatment, removal, or containment of both source material and media containing residual concentrations of COCs. The strategy includes institutional controls to prevent exposure to contaminated groundwater.

Specifically, a Classification Exception Area (CEA) would be sought in accordance with the New Jersey Department of Environmental Protection (NJDEP) regulations (New Jersey Administrative Code [NJAC] 7:26E-8.3) to serve as an institutional control providing notice

[2] AA-3 will be addressed as part of redevelopment on the Former Lever Brothers Property.

that the constituent standards are not or will not be met in a localized area due to natural water quality or anthropogenic influences. Designated aquifer uses are suspended in the affected area for the term of the CEA. The areas of the Site that are not associated with Site operations and not determined to be source areas or areas resulting in an unacceptable risk will left in but will be capped, and access will be restricted through the implementation of institutional controls. The alternative remedial strategy will also include measures to prevent the migration of dissolved phase COCs to OU2 and to address the potential risk of vapor intrusion.

This remedial strategy meets EPA's stated objectives by preventing further migration of the plume and exposure to the contaminated groundwater.

TI Zone and Site-Specific ARARs

A comprehensive delineation of all Site-related constituents has been completed and used to define the extents of OU1. Chemical-specific ARARs identified for the site include New Jersey (NJ) Groundwater Quality Standards, EPA Maximum Contaminant Levels, NJ Drinking Water Standards, and human health risk–based preliminary remediation goals (PRGs). Both Site-related and non-site-related constituents within the boundaries of OU1 that exceed one or more ARAR have been identified. In light of the site-specific factors identified in this document, an ARAR waiver is appropriate throughout the extent of OU1 for those constituents that are Site-related. However, non-site related or background constituents are also discussed in this document as they will not be targeted for remediation and therefore would be anticipated to remain present in groundwater above ARARs following remedial efforts conducted at OU1. Each of these groups of constituents are described in the following paragraphs.

Site-related constituents. Site-related constituents include all NAPL-related constituents (e.g., PAHs, non-PAH SVOCs, aromatic VOCs), ammonia and inorganics resulting from presence of pyritic waste associated with the former acid plant as well as historic fill within the boundaries of OU1 (e.g., sulfate and metals, including arsenic). If remedial strategies were selected to address all sources of these constituents, residuals remaining after treatment (i.e., areas between the NAPL zones; residual concentration in the NAPL zones; or small, as-of-yet undetected pockets of residual sources would continue to contribute to the aqueous plume and preclude the restoration of the groundwater to applicable drinking water standards. Complete treatment or removal of all material within OU1 is impracticable and cost-prohibitive.

Non-site-related constituents. These constituents are found at and adjacent to OU1 and are the result of either upgradient off-site releases, poor regional groundwater quality present throughout this area of New Jersey (e.g., sodium, chloride, iron, and manganese), or from the sporadic presence of low levels of pesticides as a result of their historic use throughout the area. The widespread presence of historic fill material containing coal, coal ash, wood ash and slag have also resulted in the presence of some of the same constituents that are Site-related (e.g., PAHs and metals, including iron and arsenic). Arsenic and to a lesser extent PAHs in historic fill adjacent to treated areas will continue to act as a source to groundwater. Constituents present as a result of poor regional groundwater quality, upgradient off-site sources (e.g., manganese, iron, sodium, chloride, hardness, bis(2-

ethylhexyl) phthalate [BEHP], and chlorinated solvents), and the sporadic historic application of pesticides will not be addressed as part of the remedy for OU1 and are expected to persist in groundwater at OU1. Furthermore, the location of the Site along the Hudson River, where the surface water in this area has been documented to be saline, would result in saltwater intrusion, should using groundwater as a potable water supply be attempted.

The waiver is applicable for Site-related constituents throughout the extent of OU1 (Figure ES-1). This is the area over which the site-specific factors are relevant and in which it is impracticable to achieve ARARs for groundwater. As described in this document, risk can be managed appropriately through the implementation of alternate remedial measures.

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Abbreviations and Acronyms

AA	arsenic area
AOC	Administrative Order on Consent
ARAR	applicable or relevant and appropriate requirement
ASA	arsenic source area
BEHP	bis(2-ethylhexyl) phthalate
bgs	below ground surface
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	constituent of concern
cSt	centistoke
DNAPL	dense non–aqueous phase liquid
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
FS	feasibility study
HCAA	high-concentration arsenic area
HHRA	human health risk assessment
IC	Institutional Controls
LNAPL	light non–aqueous phase liquid
MCL	Maximum Contaminant Level
MNA	monitored natural attenuation
NAPL	non–aqueous phase liquid
NCP	National Contingency Plan
NFA	no further action
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NZ	NAPL zone
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyls
PRG	preliminary remediation goal
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SRB	subaqueous reactive barrier

SRI	supplemental remedial investigation
SVOC	semivolatile organic compound
TI	technical impracticability
TMV	toxicity, mobility, and volume
VOC	volatile organic compound

SECTION 1

Introduction

This draft final technical impracticability (TI) evaluation has been prepared to assess the potential for restoring groundwater at the Quanta Resources Superfund Site Operable Unit (OU) 1 in Edgewater, New Jersey (the Site) as a source of potable water through achieving certain applicable or relevant and appropriate requirements (ARARs). The TI evaluation supports a waiver of ARARs, as provided by the National Contingency Plan, or NCP (40 CFR 300.400(g)(2)(v)). This TI evaluation has been prepared with EPA's input and in accordance with the EPA's *Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration* (EPA, 1993). Definitions of Site-specific terminology used throughout this document are provided in Appendix A.

An ARAR waiver is sought when site-specific conditions render it technically impracticable, from an engineering perspective, to achieve those ARARs within a reasonable timeframe. As stated by EPA (1993), "experience over the past decade has shown that restoration to drinking water quality (or more stringent levels where required) may not always be achievable due to the limitations of available remediation technologies.… EPA, therefore, must evaluate whether ground-water restoration at Superfund and RCRA ground-water cleanup sites is attainable from an engineering perspective" (p. 1).

Site-specific factors such as the long history of continuous releases, the widespread presence of dense non-aqueous phase liquid (DNAPL) and arsenic in soil and groundwater, the volume and depth of contaminated media, the complex geology and presence of low permeability material, as well as the ubiquitous nature of residual contamination and the urban nature of the Site negatively influence the practicability of groundwater restoration. Otherwise feasible technologies can become impracticable when applied to large volumes of contaminated source materials, particularly in developed, active urban site settings, as is the case with OU1. Therefore, consistent with EPA guidance, the appropriateness of an ARAR waiver is being evaluated for the Site in connection with the restoration of groundwater.

It should also be noted that offsite sources such as contaminated fill material and regional background constituents would render any restoration within OU1 futile as these sources would re-contaminate the area and continue to render groundwater unusable as a potable source for reasons outside the scope of the Quanta Resources Superfund Site. Examples include regional groundwater impacts unrelated to the Site, naturally poor groundwater quality as a result of the Site's proximity to the saline Hudson River making groundwater unsuitable to drink with average sodium concentrations of 397 mg/L and average chloride concentrations of 1,387 mg/L (acceptable concentrations are 50 and 250 mg/L respectively), and the widespread presence of historic fill material throughout the area.

The findings of this evaluation reveal that it is technically impracticable from an engineering perspective to restore groundwater at the Site. Groundwater restoration simply cannot be achieved with the available means given the contaminant-related, site-specific, and site setting factors that are present at the Site.

It is feasible, as described in the Draft Final FS Report, to implement a remedy at the site that is protective of human health and the environment and meet the site-specific Remedial Action Objectives (RAOs). The RAOs for remediation of groundwater are to:

- Prevent or minimize potential exposure by contact, ingestion, or inhalation/vapor intrusion that presents unacceptable risk; and
- Prevent migration and preferential flow of constituents of concern (COCs) to OU2 at levels resulting in risk above acceptable levels to human health or ecological receptors.

The remedial alternatives in the Draft Final FS protect human health and the environment, maintain that protection over time, and are consistent in defining and addressing risk at the site.

This evaluation documents the conditions that make it impracticable, from an engineering perspective, to achieve specific groundwater ARARs within a reasonable timeframe and also presents an alternative remedial strategy that will protect human health and the environment.

SECTION 2

Summary of Conceptual Site Model for Groundwater

This section summarizes the components of the site conceptual model relevant to groundwater. A detailed conceptual site model is included as Appendix B, and supporting information is available in the Final Remedial Investigation (RI) Report (CH2M HILL, 2008a), Draft Final Supplemental Remediation Investigation (SRI) Report (CH2M HILL, 2010a), and Draft Final Feasibility Study (FS) Report (CH2M HILL, 2010b).

Coal tar–processing and subsequent oil-recycling operations have contributed to existing secondary sources of constituents in groundwater at the site. Site-related secondary sources of polycyclic aromatic hydrocarbons (PAHs), aromatic volatile organic compounds (VOCs), and other constituents—in the form of non-aqueous phase liquid (NAPL), pitch, and residual soil contamination—have been identified, characterized, and fully delineated. A former acid plant on the northern portion of the Quanta property and southern portion of the former Celotex property contributed to the presence of oxidizing pyrite ore remnants in soil. This material is the source of the majority of the arsenic that is present at the Site. Primary sources are no longer present, with the exception of buried piping on the Quanta property. Additional secondary sources that present within OU1, which also contribute to the presence of arsenic and other metals in groundwater at the Site, include regional fill material and material impacted by former operations on adjacent properties are unrelated to former Site operations. These secondary sources are also contributing to constituents in groundwater at and adjacent to OU1.

The majority of Site-related NAPL at OU1 has been characterized as DNAPL (CH2M HILL, 2008a). Most of the contiguous free-phase and residual NAPL is present in one of six areas (or zones) that are located above and within the top few feet of the silty clay confining layer. However, NAPL and residual soil contamination is also present in smaller, thinner, noncontiguous areas throughout the Site in areas beyond the NAPL zones. In addition, surficial tar boils and eight arsenic areas have been delineated. In total, fifteen source areas have been identified as ongoing or potential sources of constituents to groundwater at the Site. These areas are detailed in Appendix B and in the Draft Final SRI Report (CH2M HILL, 2010a) and Draft Final FS Report (CH2M HILL, 2010b), and are depicted in Figure 2-1.

Much of the NAPL within the NAPL zones has accumulated in natural depressions in the surface of the silty clay confining unit or the surface of the shallower peat deposits to the west. An exception would be in those areas where elevated viscosities and interfacial tensions have prevented downward migration beyond the approximate elevation of the water table. Free-phase NAPL appears to be substantially immobile and is unlikely to affect sensitive receptors, with the possible exception of NAPL in the zones adjacent to the Hudson River. NAPL distribution near the bulkhead suggests that it has accumulated behind the bulkhead and has flanked it north and south of its extents. Both free and residual NAPL contribute constituents, primarily aromatic VOCs and PAHs, to groundwater.

Inorganic constituents are present throughout the Site. Of these, arsenic is the most widespread. Due to the presence of arsenic in soil and groundwater across the Site and at adjacent properties, above the applicable soil standards arsenic concentrations in groundwater exceed ARARs throughout, and beyond the extents of, OU1. Arsenic geochemistry at the Site is complicated. These conditions are well-documented in the Final RI Report (CH2M HILL, 2008a) and the Draft Final SRI Report (CH2M HILL, 2010a).

The solubility of arsenic is controlled by a combination of variables: pH, redox conditions (as measured by Eh), iron oxide state and content, cation exchange capacity, major ion chemistry, and the organic content of the soil. Redox conditions at the Site are controlled by the presence of NAPL and native organic material, including meadow mat and organic silt deposits that are found across significant portions of the Site. The key mechanisms and factors resulting in the presence of soluble arsenic at OU1 include the following, as detailed in the Draft Final SRI Report (CH2M HILL, 2010a, Section 5.3.1):

- Leaching of acid wastes (pyritic waste material)
- Reductive dissolution (includes arsenic associated with historic fill)
- Absorptive capacity of iron oxyhydroxides due to competition with orthophosphates

For the purposes of this evaluation, it is noteworthy that dissolved phase arsenic appears to be in steady-state under current conditions. Although most of the dissolved phase arsenic is attenuating via precipitation and adsorption to soils, in some locations, arsenic is competing with the presence of orthophosphates for binding locations. As a result, not all of the dissolved phase arsenic is precipitating. Therefore, there is the potential for some dissolved phase arsenic to migrate to OU2.

Groundwater migration from OU1 toward OU2 is impeded by the bulkhead along the shoreline, but groundwater eventually moves into OU2 as it flows to the north and south around the bulkhead and moves through areas of observed leakage in the bulkhead. A portion of groundwater at OU1 flows to the south towards a groundwater convergence zone in the central to eastern portions of the former Lever Brothers property. Within this convergence zone, impacted shallow unconfined groundwater from the central portions of the former Lever Brothers property flows to the northeast and converges with groundwater from the Quanta property. Preferential discharge zones for groundwater have been identified at OU2 (CH2M HILL, 2010a). Despite the presence of additional nearshore sources, within OU2, concentrations of dissolved-phase PAHs in shallow pore water and surface water at these zones of preferential upwelling are significantly reduced as a result of attenuation within OU2. With the exception of the groundwater-upwelling zone sampled north of the bulkhead, the SRI data suggest that concentrations of arsenic observed in pore water are a function of the arsenic within the sediment and redox conditions in proximity to nearshore NAPL sources within OU2. Upgradient groundwater data, in conjunction with hydraulic data, indicate that the low-level concentrations of arsenic in the pore water north of the bulkhead may be in part the result of the advective transport of soluble arsenic in nearshore groundwater that is two orders of magnitude higher. As identified in the SRI, based on multiple lines of evidence, the area affected by potential contaminant discharge from groundwater to surface water is limited to nearshore areas adjacent to and flanking the wooden bulkhead. As groundwater moves from source areas at OU1 adjacent to the Hudson River, it encounters additional sources of NAPL and adsorbed organic and inorganic constituents in the nearshore sediments of OU2. The areas of groundwater discharge will be further defined by the OU2 RI/FS and in pre-design phase studies for the purposes of remedial design.

Human health risk assessments (HHRAs) were conducted as part of the RI and SRI for most of the properties affected by OU1 (with the exception of River and Gorge Roads, Block 92.01, and Block 94). These HHRAs identified COCs for surface soil, subsurface soil, and groundwater. The primary risk drivers for groundwater at the site are carcinogenic PAHs, naphthalene, and arsenic.

Groundwater at the site will never be used for potable purposes within a reasonable planning horizon (e.g., 30 years) due to the poor natural groundwater quality in this area, the high potential for salt-water intrusion, and the absence of any suitable water-bearing unit that would allow the construction or extraction of a potable water source in accordance with New Jersey regulations. There are no potable wells in the vicinity of the property, and water supply planning for the area does not identify any groundwater supply needs in the vicinity of the Site. Moreover, a reliable municipal water supply is readily available. Therefore, the potable groundwater use pathway is expected to remain incomplete for the reasonably foreseeable future.

SECTION 3

Evaluation of Restoration Potential

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), groundwater restoration cleanup levels are established by chemical-specific ARARs (EPA, 1980). To evaluate the restoration potential for groundwater at OU1, both the feasibility of implementation and the effectiveness of a comprehensive remediation involving the treatment or removal of all source material within the boundary of OU1 were evaluated.

Consistent with EPA's *Guidance for Evaluating the Technical Impracticability of Ground-water Restoration* (EPA, 1993), site-specific factors which may limit the effectiveness of subsurface remediation, and therefore, the practicability of achieving groundwater ARARs at the Site, have been evaluated. The factors considered at this Site were developed based on Figure 1 of EPA's Guidance which provides examples of factors affecting groundwater restoration. Site-specific factors include hydrogeologic and contaminant-related factors, as well as some additional factors that are relevant based on the unique site setting of OU1. Specific conditions associated with each of these factors have an impact on the practicability of restoring groundwater, at the Site, from an engineering perspective. The hydrogeologic and contaminant-related factors affecting groundwater restoration potential at the Site, as well as overall site setting factors, are summarized in Figure 3-1 and described in detail below.

3.1 Technology Evaluations

Technology evaluations have been conducted as part of the FS process to identify and evaluate potential remedial technologies to address principal threat source material and dissolved-phase COCs at the Site. In addition to considering traditional technologies such as excavation and hydraulic containment, serious consideration was given to the applicability of innovative, emerging, and sustainable technologies for the restoration of groundwater quality.

Technology screening for remediation of NAPL, soil, and groundwater involved identifying technology types and process options based on professional experience, published sources, computer databases, and other available documentation. In a manner consistent with the RAOs and preliminary remediation goals (PRGs), remedial technologies were identified for free-phase NAPL, soil, and groundwater. Technologies generally fell within the categories of (1) no further action (NFA), (2) institutional controls, (3) monitored natural attenuation (MNA), (4) containment, (5) in situ treatment, and (6) physical removal and ex situ treatment or disposal. Technologies were then screened on the basis of technical implementability, effectiveness, and relative cost.

Technologies that were retained in the FS for addressing free-phase and residual NAPL as well as soil included the following:

- Institutional controls
- Soil cover

- Soil multilayer cap
- Containment
- NAPL recovery wells or trenches
- In situ solidification/stabilization
- Other in situ treatment (such as chemical oxidation)
- Excavation and offsite disposal

Those retained for groundwater remediation included:

- Institutional controls
- MNA
- Physical containment
- Reactive barriers
- In situ treatment (such as air sparging or contaminant sequestration)
- Extraction/treatment and disposal

Complete documentation of these technology evaluations is included in the Draft Final FS report (CH2M HILL, 2010b). The most feasible and appropriate technologies for the site were identified and assembled into remedial alternatives to address principal threat source material and dissolved-phase COCs by eliminating exposure pathways, thereby minimizing potential risk to human health and the environment. Although the most effective technologies for addressing Site conditions have been identified and used to assemble remedial alternatives that address RAOs and that are protective of human health and the environment, it is technically impracticable to achieve all drinking water standards for groundwater in a reasonable timeframe due to the contaminant and hydrologic factors as well as the additional Site-specific factors described in the following sections.

3.2 Contaminant-Related Factors

Based on the risk evaluations performed as part of the RI and SRI, two primary contaminant types are driving risk, and therefore remedial decision making, at OU1: free-phase and residual NAPL and arsenic. The majority of Site-related NAPL at OU1 has been characterized as DNAPL (CH2M HILL, 2008a). As shown on Figure 3-1**,** contaminant characteristics that have been observed at the Site and which may limit the effectiveness of subsurface remediation include: the large volume and depth of source material, the fact the majority of the source material is DNAPL, the long site history of a continuous release, the low potential for biotic/abiotic decay of the material, its low volatility, and high sorption potential. In addition, the co-location of arsenic and DNAPL was also considered.

3.2.1 NAPL

With a release history dating back to the late 1800s the volume of soil containing NAPL and NAPL-related constituents at the Site extends beyond the boundaries of former Site operations and is estimated to be close to 1 million cubic yards (yd^3). Spanning an area of approximately 24 acres and extending to depths of up to 30 feet below ground surface (bgs), the volume and depth of NAPL contaminated media present significant challenges to restoring groundwater at the Site.

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At OU1, NAPL distribution and mobility is density driven and controlled largely by the NAPL viscosity and the lithologic interfaces and capillary barriers, because the majority of NAPL is denser than water (DNAPL) and typically immiscible and non-wetting. As such, it can be found accumulated at lithologic interfaces where NAPL pressure, or the displacement pressure, is insufficient to exceed the pore entry pressure of the underlying unit. In this situation, NAPL will tend to pool in the depressions in the surfaces of these units and may rest confined in-place. A change in any of the characteristics mentioned above will result in a shift in NAPL architecture and may result in a change in NAPL mobility if lithologic and capillary barrier conditions allow.

Using state-of-the-art technologies the location, nature, and extent of NAPL at OU1 has been defined to the extent practicable through extensive investigative work that involved the completion of over 105 soil borings, 126 laser-induced fluorescence borings, and the collection of groundwater and NAPL samples from 72 monitoring wells. The comprehensive investigative work that was performed in an iterative manner over a period of approximately 12 years has resulted in a reasonable bounding of site-related NAPL and the definition of six discrete NAPL zones (NZ-1 through NZ-6) where the majority of source material is located. Additional information on the migration of NAPL and the characteristics of each NAPL zone is provided in Appendix B. Regardless of the large effort expended to characterize these source materials using the best available technologies, uncertainties in the estimate of the total NAPL mass present in the source zone will always remain because of the effects of geologic heterogeneity and the spatial heterogeneities in NAPL distribution (EPA, 2003).

It was determined by an expert panel assembled by the U.S. EPA's Environmental Research Center in Ada, Oklahoma in 2001 that, "at most sites, characterization of the location, distribution, and amount of DNAPL causing continued groundwater contamination is difficult, and often inaccurate. Removal or in-situ destruction of DNAPL, even when reasonably well characterized, has proven difficult in saturated zones with any significant degree of heterogeneity" (EPA, 2003). DNAPL constituents, they note, "partition slowly into the aqueous phase (Eberhardt and Grathwohl, 2002), usually under mass transfer controlled conditions (see e.g., Frind et al., 1999) thus causing the development of a dissolved groundwater contaminant plume…For coal tars and creosote NAPLs, the primary constituents of concern are the PAHs, with a broad range of solubilities and susceptibility to biological degradation"(EPA, 2003).

The contaminant phase (i.e., DNAPL) as well as the long duration of the release and the volume and depth of impacts are significant contaminant-related factors that will affect the technical practicability of completely addressing Site-related sources to groundwater. Furthermore, the abundance of high adsorption potential, low-volatility and low-solubility semivolatile organic compounds (SVOCs) (primarily PAHs) present as components of the NAPL at OU1 and the relatively low potential of these constituents to decay biotically or abiotically, are also significant additional contaminant-related factors that contribute to the difficulty of addressing these sources and ultimately restoring groundwater.

3.2.2 Arsenic

The widespread distribution of metals in soils across the Site and the redox-sensitive nature of this constituent represent important contaminant-related factors that affect the technical practicability of restoring groundwater at the Site. The distribution of arsenic at OU1 is consistent with the location of former pyritic roasting operations associated with the former acid plant and with the sporadic distribution of smaller arsenic hotspots present throughout the historic fill also being present at neighboring properties.

Beyond the area of the former pyritic roasting operations, and across all the properties in the area, fill deposits comprised of varying amounts of coal, cinders, slag, and elevated levels of arsenic and other metals are ubiquitous. These anthropogenic deposits resulted from the systematic infilling aimed at raising the topographic elevation of the tidal wetlands that dominated this area along the banks of the Hudson River until the mid 1800s. As a result of leaching and dissolution that is promoted by NAPL and other sources of dissolved organics in groundwater, arsenic concentrations both within and beyond OU1 exceed ARARs. Soils with levels of arsenic that exceed specific risk criteria or that have been determined to be significant sources to groundwater have been defined as arsenic areas (AAs). The eight AAs are depicted on Figure 2-1. However, due to the nature and ubiquity of the anthropogenic historic fill throughout this area of Edgewater, concentrations of metals unrelated to operations associated with the former acid plant have also been consistently observed above ARARs outside of these areas.

While pyritic material could be physically removed or treated, the presence of additional sources in fill material present over the entire area of OU1 as well as at adjacent properties would continue to leach arsenic to the groundwater because of the geochemical factors described above. Therefore, any permanent restoration of groundwater conditions at the Site must also either remove the fill material sources or control the Site geochemistry throughout OU1. The impracticability of removal or treatment of all source areas and interstitial source material is discussed in Section 3.5.1. Permanent modification of geochemical conditions is impracticable as long as organic material, which has likely been present in the area since before original filling and development, remains present at quantities sufficient to maintain a reducing environment.

3.3 Hydrogeologic Factors

The hydrogeologic characteristics that have been observed at the Site and which would limit the effectiveness of subsurface remediation include the complex geology (interbedded and discontinuous strata), the heterogeneous nature of the soils, and the presence of low-permeability fine-grained materials including clays and peat.

Soil impacted by former Site operations consists predominantly of heterogeneous fill material and deposits of native sand, peat, and organic silt in contact with shallow groundwater. With the exception of areas to the north, where a bedrock high is present, these units are underlain by a silty clay confining layer at a depth of approximately 7 to 80 feet bgs, ranging in thickness from 2 to 35 feet. South of the bedrock high, a confined, water-bearing “deep sand” unit lies between the aquitard (confining unit) and the bedrock or glacial till surfaces. This deeper sand unit is approximately 7 to 32 feet thick and slopes downward to the south and east away from the bedrock high and is not considered to be affected by historical operations associated with OU1.

The stratigraphy and heterogeneity of the fill and native deposits are significant engineering challenges for the implementation of the technologies that have been considered at the Site, and would pose difficulty for any technology requiring uniform injection of reactants into the subsurface or bulk extraction of groundwater. Small or inconsistent radii of influence for injection and/or extraction wells could complicate the design and widespread implementation of any such technology to the extent that the technology's effectiveness would be limited. The success of in-situ technologies as well as excavation would also be challenging as it would rely on overcoming the difficulty of identifying and accessing all thin discontinuous stringers of contamination that are inherently present in interbedded and heterogeneous hydrologic settings such as this. Although both excavation and select in-situ technologies would work well at addressing a large majority of both the organic and inorganic sources at the site as documented in the Draft Final FS Report (CH2M HILL, 2010b), their success at restoring groundwater would depend on identifying and addressing even the smallest residual sources. Residuals remaining after treatment would still provide ongoing sources of constituents to groundwater.

3.4 Additional Factors

The highly urbanized environment and significant surficial and subsurface infrastructure present at the Site render the application of many technologies impracticable**.** Other site-specific factors may also limit the effectiveness of remediation and (or) limit the applicability of certain technologies, or render complete restoration futile, such as the presence of contaminated fill material, the presence of upgradient sources, the poor quality of regional groundwater, and potable well construction requirements. Figure 3-2 shows the various classes of constituents that are above ARARs in upland groundwater adjacent to OU1 that are unrelated to the Site and that are also factors that contribute to the unsuitability of groundwater in this area for use as a potable supply.

3.4.1 Contaminated Fill Material

The Site and surrounding area was raised in elevation by the import of fill materials as part of reclamation efforts along the Hudson River during the 19th century. Extensive soil- and groundwater-sampling results from OU1 and the surrounding properties indicate that the regional fill at the Site and at adjacent properties presently constitute ongoing sources of metals and to a lesser extent, PAHs, which have caused exceedances of the applicable federal and state water quality standards (CH2M HILL, 2008a). Fill material both within and upgradient of the site contributes to regional groundwater degradation; therefore, even if all fill material were removed from OU1 and replaced with certified clean backfill, upgradient offsite fill material would remain and serve as a continuous source of COCs to groundwater. Groundwater at the Site cannot be remediated to applicable drinking water standards unless all sources associated with the fill are addressed and. as discussed below in Section 3.5, this is not feasible.

3.4.2 Other Off-Site Sources

Some limited detections of chlorinated solvents have been observed in the shallow upgradient groundwater at the foot of the Palisades (i.e., on Block 94) and in deeper confined groundwater; they are likely from upgradient releases (CH2M HILL, 2010a). Shallow groundwater at Block 94 is hydraulically upgradient of Block 93 and the areas of former industrial operations associated Quanta property. Sporadic exceedances of chlorinated solvents and polychlorinated biphenyls (PCBs) unrelated to the OU1 have also been observed to the north of the Site at City Place. To the south of OU1 historical operations have resulted in exceedances of the ARARs for VOCs, PAHs, metals (including arsenic), and other inorganics. Finally, directly to the east of the Site at OU2, additional sources of NAPL exist within river sediments that have resulted in concentrations of PAHs, VOCs in the deeper pore water, and to a lesser extent, the shallow pore water of the Hudson River. Groundwater at the Site cannot be remediated to applicable drinking water standards unless the offsite sources, particularly those immediately adjacent or upgradient, are addressed.

3.4.3 Regional Water Quality

Groundwater samples collected from monitoring wells beyond the extents of OU1 at background wells (MW-M, MW-J, MW-124, and MW-125) as well as at adjacent properties (e.g., the former Lever Brothers property) are in excess of the NJDEP drinking water criteria for sodium, chloride, manganese, hardness, and total suspended solids among other parameters outlined in the NJDEP guidance. This is likely a function of the former estuarine setting that once dominated this area and the subsequent infilling that took place as well as the Site's proximity to the saline water of the Hudson River.

The location of the Site along the Hudson River, where the surface water in this area has been documented to be saline, would result in saltwater intrusion, should using groundwater as a potable water supply be attempted. The U.S. Geological Survey defines the saltwater–fresh water interface as the farthest daily upstream location that has 100 mg/L of chloride concentration and depicts this front as being approximately 5 miles south of West Point, New York (Hoffman, 2008). This location is several miles upstream of the Site. Salt water in the Hudson River has also been documented to extend to the first 100 km of the river during low flow and 30 km during freshet periods, or times of sudden flooding, such as rapid thaw or heavy rainfall periods (Traykovski et al., 2004). Based on the NJDEP guidance document on water supply wells (NJDEP, 2007), saltwater intrusion from the river would preclude the use of groundwater from the Site as a potable water supply.

3.4.4 Non-contaminant Factors Preventing Potable Use

In addition to the poor quality of the groundwater precluding its use as a potable supply, the NJDEP water supply well construction regulations prohibit using the shallow aquifers when developing water supplies. NJDEP requires that potable water supply wells be installed within unconsolidated formations with well casings that are at least 50 feet deep, with a minimum of 50 feet of grout seal extending from the top of the gravel pack or top of the well screen to grade (NJDEP, 2007). Because the overburden at the Site is confined to depths shallower than 50 feet, this requirement could not be achieved at the Site (CH2M HILL, 2008a). In addition, NJDEP regulations require that the construction of a water supply well's pump house floor be above the elevation of the 100-year flood plain (NJDEP, 2004). Satisfying this requirement at the Site is also not feasible because the majority of the Site lies within the 100-year floodplain (CH2M HILL, 2008a).

3.5 Comprehensive Remediation Evaluation

Partial removal of sources will not achieve groundwater restoration; therefore, the comprehensive removal or treatment of all source material was evaluated. The two most feasible technologies (in-situ solidification/stabilization and excavation) were evaluated as means to address OU1 in its entirety. This approach includes the demolition of multiple buildings private roadways, parking areas and portions of River Road, Old River Road and Gorge Road in order to access and address all source material within the footprint of OU1 as defined in Draft Final SRI Report and shown on Figure 2-1. A combination of technologies was considered for this approach to more closely represent actions that would likely be taken if such a remedial effort were to be undertaken. A detailed description of the comprehensive remediation evaluation is presented in Appendix C. An evaluation of the comprehensive remediation has resulted in the determination that the approach is not practicable, from an engineering perspective, for the purpose of long-term groundwater restoration for potable use.

3.5.1 Practicability Evaluation for Comprehensive Remediation

We have evaluated a combination of technologies that may be used in an effort to perform the most comprehensive subsurface remediation with the objective of restoring groundwater in a reasonable timeframe. Logistically, the implementation of a combination of solidification/stabilization and excavation/offsite disposal over a 24-acre area with active traffic corridors, residences, and commercial activity would be extremely complex. Management of traffic alone would require staging construction activities and constructing alternate traffic routes in the area to maintain emergency services and allow continued access to homes and businesses adjacent to OU1.

From an administrative perspective, it is unlikely that town and other local stakeholders would agree to this level of disruption when risk may be managed in other (significantly less disruptive) ways. Furthermore, the demolition of buildings on multiple privately-owned properties and the relocation of tenants are likely to result in litigation that would significantly delay remedy implementation.

The negative impact on the local economy and businesses for at least 5 years during active construction is likely to be unacceptable to the public and local government when other less-disruptive approaches to managing risk are available, and given that it is unlikely that groundwater at the Site could ever be used as a potable source, regardless of site-related conditions (Section 3.3).

Even if the logistical and administrative challenges could be overcome and public support for the comprehensive remediation approach were gained, at a cost of $400 and $900 million (Appendix D), the approach is so expensive as to be considered cost-prohibitive.

3.5.2 Effectiveness Evaluation for Comprehensive Remediation

Although the comprehensive remediation would address the greatest quantity of source material from OU1, it still carries with it enough uncertainty as to preclude an estimation of the timeframe to achieve ARARs. Both excavation and in-situ technologies carry with them the uncertainty as to whether all of the material located throughout the 24-acre OU1 Site can be effectively identified, accessed and addressed appropriately, particularly in this active urban setting where there is significant and vital infrastructure already in place. Any relatively small remnant amount of Site NAPL or soil contamination that remained unaddressed would continue to contribute constituents to groundwater and cause an exceedance of drinking water standards in perpetuity.

Even if the removal or treatment was completely successful within the boundary of OU1, off-site sources and regional characteristics (i.e., presence of fill throughout the area as well as upgradient sources) would re-contaminate groundwater within OU1 and prevent the achievement of certain ARARs and the absence of conditions required for constructing water supply wells and extraction systems in compliance with New Jersey state law. Additionally, the likelihood of saltwater intrusion from the Hudson River would prevent the use of groundwater as a potable water supply.

Beyond the downgradient boundary of OU1 the comprehensive remediation would have very little benefit. Given the additional NAPL and NAPL-related constituents present in the deeper sediments downgradient of OU1 in OU2, eliminating the relatively small and indistinguishable mass of dissolved impacts coming from OU1 via groundwater would not add any significant incremental risk benefit to the resource.

3.6 Conclusions of Restoration Potential Evaluation

As discussed in Sections 3.2, 3.3, and 3.4, there are significant Site-specific factors that limit the ability of available remedial technologies to achieve groundwater ARARs at the Site. These include contaminant-related and hydrogeologic factors, as well as the overlying urban development and poor regional groundwater quality associated with the Site setting.

The widespread presence of DNAPL comprised of low volatility low solubility recalcitrant compounds, the long history of continuous releases, the volume and depth of contaminated media, the presence of undulating layers of heterogeneous interbedded low permeability materials and the redox conditions at the Site are all contributing factors to the restoration of groundwater at the Site being technically impracticable. Residual NAPL, in the form of DNAPL, is distributed among heterogeneous layers of interbedded sands, silts and clays, primarily below the water table. The combination of the widespread presence of NAPL, fate and transport characteristics of DNAPL, and hydrogeologic conditions limit the effectiveness of remedial technologies to remove these source materials in their entirety. Furthermore, the presence of active roadways, intersections, and commercial properties also contribute to the difficulty of any available technologies to access and treat all sources to groundwater.

If remedial strategies were selected to address all source materials (including those under active roadways and commercial properties), residuals remaining after treatment (i.e., areas between the NAPL zones, potential residual concentration in the NAPL zones, or small, as-of-yet undetected micro-stringers of residual NAPL and soil contamination) would continue to contribute to the aqueous plume of inorganic and organic constituents and prevent remediation of the groundwater to applicable drinking water standards.

Regardless of the level of remedial efforts that could be expended at OU1, the presence of off-site sources and regional characteristics would render any restoration within OU1 futile, as these sources would recontaminate the area and continue to render groundwater unusable as a potable source for reasons beyond the scope of the Quanta Resources Superfund Site. Further, conventional water resource planning practices render impossible the potential for the potable use of groundwater in the area.

Considering the groundwater flow paths and the presence of NAPL and NAPL-related constituents in the deeper sediments downgradient of OU1 in OU2, the elimination of sources of dissolved phase constituents at OU1 will have relatively little, if any, benefit towards the goal of addressing human health and ecological risks at OU2. The OU2 RI/FS will evaluate remedial alternatives for addressing free-phase NAPL and NAPL-related constituents in sediments.

The comprehensive remediation approach is neither practicable nor feasible, and in consideration of the uncertainty surrounding its ultimate effectiveness at achieving ARARs within a reasonable time frame and the presence of off-site sources and poor regional groundwater quality, the $400 and $900 million cost of this approach is unwarranted.

SECTION 4

Alternative Remedial Strategy

The evaluation of groundwater restoration potential has resulted in a determination that it is technically impracticable to restore groundwater at the Site within a reasonable timeframe. Therefore, consistent with EPA's guidance, EPA's goal of restoring groundwater may be modified and an alternative remedial strategy would be selected. As stated in EPA's (1993) guidance,

> EPA's goal of restoring contaminated groundwater within a reasonable timeframe at Superfund … sites will be modified where complete restoration is found to be technically impracticable. In such cases, EPA will select an alternative remedial strategy that is technically practicable, protective of human health and the environment, and satisfies the statutory and regulatory requirements of the Superfund … program.

EPA's TI guidance requires the development of alternative remedial strategy that considers exposure control, source control, and aqueous plume remediation in light of site-specific conditions. The following presents an alternative remedial strategy for OU1 that is technically practicable, protective of human health and the environment, and satisfies the statutory and regulatory requirements of the Superfund program.

4.1 Remedial Action Objectives

Alternative remediation goals to protect reasonably foreseeable uses/exposure to groundwater must be selected in lieu of waived ARARs. These goals, once achieved, must ensure a condition of protectiveness without achieving specific ARARs that have been determined to be technically impracticable to achieve.

Remedial action objectives (RAOs) were developed during the FS process to achieve protection of human health and the environment. The two RAOs for groundwater that were developed as part of the FS are as follows:

- Prevent/minimize potential exposure by contact, ingestion, inhalation/vapor intrusion that presents unacceptable risk; and
- Prevent migration and preferential flow of COCs to OU2 at levels resulting in risk above acceptable levels to human health or ecological receptors.

4.2 Alternative Remedial Strategy: In Situ Solidification/Stabilization with a Subaqueous Reactive Barrier

Alternatives were developed and evaluated in the FS to meet site RAOs. Of the alternatives developed, the most feasible and cost-effective alternative to achieve RAOs is Alternative 4a, NAPL and Arsenic In Situ Solidification/Stabilization with subaqueous reactive barrier (SRB). The complete development, evaluation, and comparative analysis of the FS alternatives are presented in the FS Report. Alternative components addressing source areas and groundwater are summarized below.

OU1 data were evaluated in accordance with EPA guidance to determine the locations of principal threat and low-level threat wastes. A principal threat waste is considered to be highly toxic or highly mobile source material that generally cannot be reliably contained or would potentially present a significant risk should exposure occur. A low-level threat waste is source material that generally can be reliably contained and would pose only a low potential risk should it be exposed. EPA expects to use "treatment to address principal threats posed by a site, wherever practicable" and "engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable" (40 CFR Section 300.430(a)(1)(iii)).

4.2.1 Source Areas

Non–Aqueous Phase Liquid

Principal-threat NAPL (present at NAPL zones [NZ]-1, NZ-2, and NZ-5 and from tar boils) would be solidified/stabilized in situ. In situ solidification/stabilization reduces the mobility of principal threat waste. This method sequesters COCs to reduce the potential for NAPL mobility and reduce leaching to groundwater. In addition, passive NAPL recovery would be conducted at a select number of existing wells to remove NAPL mass from existing well installations screened in NZ-3 and NZ-4 where conditions may be amenable to NAPL recovery. Soil underneath the 115 River Road building would not be stabilized because the exposure pathway can be addressed via other means, such as engineering controls. Principal-threat NAPL on the Block 93 property could be solidified/stabilized either in situ or ex situ.

Prior to implementation of in situ solidification/stabilization, the area would be cleared of vegetation and excavated for surface and subsurface debris removal (including large boulders, tank pads, conduits, and concrete), and these materials would be disposed of offsite. A temporary barrier may be installed along the shoreline to mitigate NAPL migration during implementation and to act as a turbidity barrier.

Solidification of NZs would be performed to address principal threat criteria at NZ-1 to 11 feet, at NZ-2 to 25 feet within 6 to 8 feet of the bulkhead and then to 10 feet bgs further inland, and at NZ-5 to 25 feet within 6 to 8 feet of the bulkhead.

Soils underneath the 115 River Road building would not be solidified; however, the potential exposure pathway under the building to the river would be addressed. A cutoff wall would be created to prevent potential NAPL migration from under the building.

Principal Threat Arsenic

Principal threat arsenic and the HCAA would be addressed with solidification/stabilization. .

4.2.2 Groundwater

HCAA Process Option

If treatability testing were to indicate that the in situ stabilization of arsenic is not feasible for the HCAA (e.g., uncertainty of long term permanence or reagent delivery constraints), it is assumed that hydraulic containment of the groundwater would be implemented as a contingency process option. A barrier cutoff wall with groundwater extraction wells would be installed downgradient of the HCAA, with ex situ treatment of extracted groundwater prior to discharge.

Subaqueous Reactive Barrier

A SRB would be installed in OU2 to mitigate migration of residual COCs in groundwater prior to discharge to surface water, if necessary. The proposed use of the SRB for groundwater is a contingency component of the proposed remedial alternatives to address uncertainty related to the degree of attenuation of OU1 dissolved-phase constituents and residual NAPL prior to their being discharged to OU2.

The SRB would be a permeable subaqueous covering placed over sediments in OU2 to reduce COC concentrations (e.g. benzene, naphthalene, and arsenic, as warranted, pending design phase assessments) in groundwater as the pore water discharges by advection through the sediments to the surface water. The SRB would be designed to mitigate various sources of constituent loading and NAPL sheens originating from OU1, as well as sources within the OU2 river sediments. It is anticipated that the SRB might consist of a combination of organoclay, apatite, and activated carbon.

Natural Attenuation and Groundwater Monitoring

Attenuation of both the organic constituents and arsenic is occurring now before source solidification/stabilization within and downgradient of OU1 (CH2M HILL, 2008a, 2010a). In general, time-versus-concentration plots and Mann-Kendall statistical trend analyses show that the composite extent of both the organic constituents and arsenic in groundwater is not currently expanding beyond its current boundaries. Attenuation mechanisms include degradation, adsorption, dispersion, dilution from recharge, and volatilization. Adsorption and degradation reactions are the most dominant factors in dissolved constituent fate and transport at the Site.

As part of this alternative, monitoring of groundwater would be completed to verify that natural attenuation is occurring, and that the footprint of Site-related groundwater impacts is not increasing.

4.2.3 Vapor

Although vapor intrusion studies have concluded that vapor intrusion pathways are unlikely to be present or do not to pose an unacceptable human health risk to the occupants of buildings at OU1 under current conditions (CH2M HILL, 2008a), the need for vapor intrusion controls at all buildings within the footprint of OU1 will be evaluated in light of remedial measures and additional engineering controls and other mitigation measures will be incorporated into the remedial alternative as necessary.

4.2.4 Institutional Controls

The institutional controls to limit exposure to groundwater in Alternative 4a include construction restrictions and groundwater use restrictions. In addition, engineering controls would be established to restrict dredging or other activities that could compromise the integrity of the SRB.

4.3 Evaluation of Alternative Remedial Strategy

The proposed alternative remedial strategy is designed to prevent exposure and reduce risk per EPA's (1993) objective "…to prevent further migration of the contaminated groundwater plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction measures as appropriate" (NCP 300.430(a)(1)(iii)(F)).

In Alternative 4a of the FS, an alternative remedial approach minimizes the potential for exposure to groundwater, addresses significant volumes of source materials, and addresses the aqueous plume prior to its reaching the surface water at OU2.

- Tar boils and NAPL identified as a principle threat (e.g., NZ–1, NZ-2, and NZ-5) are solidified/stabilized in situ.
- The high-concentration arsenic area (HCAA) and defined arsenic areas are stabilized in situ.
- If treatability testing were to indicate that the in situ stabilization of arsenic is not feasible for the HCAA, it is assumed that hydraulic containment of the groundwater within the HCAA would be implemented as a contingency process option.
- All potential exposure pathways for both soil and groundwater impacts remaining are addressed through vapor mitigation measures and/or institutional controls.
- A SRB is included as a contingency component pending the outcome of OU2 risk assessments; the SRB would be installed in OU2 to mitigate migration of residual COCs in groundwater prior to discharge to surface water, if necessary.

Through implementation of this alternative remedial strategy, EPA's objectives are met. A complete evaluation of Alternative 4a against the nine NCP evaluation criteria is included in the FS Report. Although chemical-specific ARARs for groundwater are not achieved, the alternative presents an approach to cost-effectively remove or treat principal threat waste and manage residual risks within a reasonable timeframe. Short-term disruption to the community is minimized, and risks during construction are manageable through engineering controls. The alternative remedial strategy presents a balanced approach to remediate the site, in lieu of disruptive and cost-prohibitive options that still could not provide assurance of long-term groundwater restoration.

SECTION 5

Site-Specific ARARs for Which Waiver is Requested

Chemical-specific ARARs identified for the site include NJ Groundwater Quality Standards, EPA Maximum Contaminant Levels (MCLs), NJ Drinking Water Standards, and human health risk–based preliminary remediation goals (as presented in the FS Report). The RI and SRI reports have identified those constituents that are present in groundwater at the Site as a result of historical site operations as well as those that are the result of non-site related conditions (e.g., upgradient off-site sources and regional groundwater conditions). This section presents the list of Site-related constituents for which an ARAR waiver is requested and also identifies those constituents present in OU1 groundwater above ARARs exclusively as a result of non-site related sources. Although a waiver is not requested for the latter group of constituents it is important to document these groundwater conditions as remedial actions undertaken for the Site are not designed to address these constituents and they are expected to persist at the Site in groundwater above their respective ARARs.

5.1 Site-Related Constituents

A comprehensive delineation of all Site-related constituents has been completed and used to define the extents of OU1 as depicted in Figure 2-1. Site-related constituents within the boundaries of OU1 that exceed one or more ARAR and for which an ARAR Waiver is appropriate are listed below.

VOCs	SVOCs	Metals & Other Inorganics
1,2,4-Trichlorobenzene	2-Methylnaphthalene	Aluminum
Benzene	Acenaphthene	Antimony
Chloroethane	Acenaphthylene	Arsenic
Ethylbenzene	Benzo(a)anthracene	Beryllium
Styrene	Benzo(a)pyrene	Cadmium
Toluene	Benzo(b)fluoranthene	Cobalt
Xylenes, m/p-	Benzo(g,h,i)perylene	Iron
Xylenes, Total	Benzo(k)fluoranthene	Lead
	Chrysene	Mercury
	Dibenzo(a,h)anthracene	Nickel
	Fluoranthene	Selenium
	Fluorene	Thallium
	Indeno(1,2,3-cd)pyrene	Zinc

VOCs	SVOCs	Metals & Other Inorganics
	Naphthalene	Sulfate
	Phenanthrene	Ammonia
	Pyrene	
	2,4-Dimethylphenol	
	Biphenyl	
	Dibenzofuran	
	Nitrobenzene	
	Pentachlorophenol	
	Phenol	

For the reasons discussed in Section 3, an ARAR Waiver is appropriate for each of the Site-related constituents as listed above. Site-related constituents include all NAPL-related constituents (e.g., PAHs, non-PAH SVOCs, aromatic VOCs), ammonia and inorganics resulting from pyritic waste associated with the former acid plant as well as the presence of historic fill within the boundaries of OU1 (e.g., sulfate and metals, including arsenic). If remedial strategies were selected to address all sources of these constituents, residuals remaining after treatment (i.e., areas between the NAPL zones; residual concentration in the NAPL zones; or small, as-of-yet undetected pockets of residual sources would continue to contribute to the aqueous plume and preclude the restoration of the groundwater to applicable drinking water standards. Complete treatment or removal of all material within OU1 is impracticable and cost-prohibitive. ARARs for each of the Site-related compounds for which an ARAR Waiver is appropriate are listed in Table E-1 of Appendix E.

5.2 Non-Site Related Constituents

As noted above additional **constituents** are also present at and adjacent to OU1 as the result of non-site related conditions (e.g., upgradient off-site sources and regional groundwater conditions). As a result of the presence of historic fill material containing coal, coal ash, wood ash and slag**.** Non-site related constituents also include some of the same constituents that are Site-related (e.g., arsenic, iron, and PAHs). A list of the constituents that exceed ARARs in groundwater at OU1 that are unique only to non-site related conditions is presented below.

VOCs	SVOCs	Metals & Other Inorganics	Pesticides
1,1-Dichloroethane	BEHP	Manganese	4,4'-DDD
1,2-Dichloroethane		Sodium	4,4'-DDE
Tetrachloroethene		Chloride	alpha-BHC
Trichloroethene			
Vinyl chloride			

The presence of these constituents in groundwater at OU1 have resulted from either off-site releases (chlorinated solvents and bis(2-ethylhexyl) phthalate (BEHP)), the general poor regional groundwater quality present throughout this area of New Jersey (e.g., sodium, chloride, and manganese), or from the sporadic presence of low levels of pesticides as a result of their historic use throughout the area. A summary of these constituents and their lowest applicable ARARs is included as Table E-2 of Appendix E. Although a waiver of ARARs for each of the non-site related constituents listed above is not appropriate as they are unrelated to OU1, it is important to note their presence in groundwater; these constituents will not be targeted for remediation and would be expected to persist in groundwater above their respective ARARs. Furthermore, constituents present as a result of poor regional groundwater quality or upgradient off-site sources (e.g., manganese, iron, sodium, chloride, bis(2-ethylhexyl) phthalate (BEHP), and chlorinated solvents) could not be controlled and would recontaminate groundwater at OU1 even if all onsite sources could be addressed.

A complete list of the Site-related constituents and their chemical-specific ARARs which have been determined to be impracticable to achieve and for which an ARAR Waiver is requested is included as Table E-1 in Appendix E. Non-site-related or background constituents for which an ARAR Waiver is not applicable, but which are anticipated to persist in groundwater above ARARs are summarized in Table E-2. Additional detail on Site-related and non-site-related sources are presented in the RI and SRI reports.

SECTION 6

Spatial Extent of TI Zone

As indicated in EPA (1993) guidance, “where EPA determines that groundwater restoration is technically impracticable, the area over which the decision applies … generally will include all portions of the contaminated groundwater that do not meet the required cleanup levels.” The site-specific factors precluding groundwater restoration are present throughout the Site, and groundwater concentrations measured in all wells within the boundaries of OU1 exceed one or more groundwater ARAR. A waiver of the ARARs noted above in section 5 is appropriate for the entire area of OU1 (TI Zone).

Vertically, the TI zone should include all groundwater from the water table down to an elevation that corresponds to 5 feet below the silty clay confining unit or to the top of bedrock, whichever is encountered first. The lateral extent of the TI zone and the elevation of the base of the zone are depicted in Figure 6-1.

As discussed in Section 3.4, there are areas outside of OU1 and outside the TI Waiver zone that do not achieve groundwater ARARs for non-Site-related reasons (Figure 3-2). These reasons might include impacts from other, unrelated sites; impacts from the ubiquitous presence of contaminated fill material throughout the region; elevated regional background concentrations as a result of naturally poor groundwater quality throughout the area; or other similar considerations.

SECTION 7

Conclusion

A Technical Impracticability Waiver of specific ARARs is appropriate for on-Site groundwater due to the infeasibility of restoring groundwater within a reasonable timeframe. As discussed in Sections 3.2, 3.3, and 3.4, there are significant Site-specific factors that limit the ability of available remedial technologies to achieve groundwater ARARs at the Site. These include both contaminant-related and hydrogeologic factors, and include:

Contaminant-related factors such as:

- The widespread presence of dense non–aqueous phase liquid (DNAPL) and recalcitrant DNAPL-related constituents
- The long history of industrial use and related releases at the Site
- The volume and depth of contaminated media
- The presence of arsenic in soil and groundwater, and the co-location of arsenic and DNAPL

Hydrogeologic factors such as:

- The complex geology consisting of interbedded and undulating layers of sands, silts and clays with discontinuous peat deposits
- Heterogeneous soil conditions and the presence of low permeability materials such as silts and clays

Site-setting factors such as:

- The highly urbanized environment with significant surficial and subsurface infrastructure

If remedial strategies were selected to address all source materials (including those under active roadways and commercial properties), residuals remaining after treatment (i.e., areas between the NZs), potential residual concentration in the NZs, or small, as-of-yet undetected micro-stringers of residual NAPL and soil contamination would continue to contribute to the aqueous plume of inorganic and organic constituents and prevent remediation of the groundwater to applicable drinking water standards. Like alternative remedial measures presented in the Draft Final FS Report (CH2M HILL, 2010b) restoration of the OU1 groundwater at the Site in this comprehensive remediation scenario would not be achieved, and additional measures would be required in order to protect human and ecological receptors.

Regardless of the level of remedial efforts that could be expended at OU1, the presence of off-site sources and regional characteristics would render any restoration within OU1 futile, as these sources would recontaminate the area and continue to render groundwater unusable as a potable source for reasons beyond the scope of the Quanta Resources

Superfund Site. Further, conventional water resource planning practices render impossible the potential for the potable use of groundwater in the area. Such factors that have been considered at the Site include the poor regional groundwater quality (e.g. MCL exceedances of sodium, chloride, manganese, and upgradient sources of chlorinated solvents and metals), and the likelihood of saltwater intrusion given its proximity to the Hudson River, as well as drinking water well construction requirements.

Beyond the downgradient boundary of OU1, the comprehensive remediation approach would have very little benefit as additional sources of NAPL and NAPL-related constituents present in the deeper sediments of OU2 would recontaminate groundwater as it moved from OU1 through these sources. The elimination of the relatively small and indistinguishable mass of dissolved impacts coming from OU1 via groundwater will have minimal benefit to the resource. The OU2 RI/FS will evaluate remedial alternatives for addressing free-phase NAPL and NAPL-related constituents in sediments; however, the conditions are similar to OU1, where there are areas of free-phase NAPL and then extensive zones of more diffuse NAPL, making restoration impracticable even in the river sediments.

When restoration of groundwater to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction" (NCP Section 300.430(a)(1)(iii)F)). In accordance with the EPA's TI guidance, an alternative remedial strategy that considered exposure control, source control, and aqueous plume remediation in light of site-specific conditions was developed. Referred to as Alternative 4a in the Draft Final FS Report, NAPL and Arsenic In Situ Solidification/Stabilization was determined to be best-suited for achieving RAOs for the Site. This alternative approach is protective of human health and the environment and consistent with the RAOs that were developed for the Site during the FS process to achieve protection of human health and the environment.

The major components of Alternative 4a that will significantly reduce the volume of source material that is contributing to COCs, minimizes the potential for exposure to groundwater, and address the aqueous plume include:

- Tar boils and NAPL identified as a principle threat (e.g., NZ–1, NZ-2, and NZ-5) are solidified/stabilized in situ.
- The HCAA and defined arsenic areas are solidified/stabilized in situ.
- If treatability testing were to indicate that the in situ stabilization of arsenic is not feasible for the HCAA, it is assumed that hydraulic containment of the groundwater in the HCAA would be implemented as a contingency process option.
-
- All potential exposure pathways for both soil and groundwater impacts remaining are addressed through vapor mitigation measures and/or institutional controls.
- A SRB would be installed in OU2 to mitigate the potential for any COCs that remain in OU1 groundwater to discharge to surface water, if necessary.

This alternate remedial strategy prevents unacceptable human health and ecological risk by eliminating exposure pathways through treatment, removal, or containment of both source

400492

material and media containing residual concentrations of COCs. The strategy includes institutional controls to prevent exposure to contaminated groundwater and minimize risk at the Site. This remedial strategy meets EPA's stated objectives by preventing further migration of the plume and exposure to the contaminated groundwater.

Attempting to implement a comprehensive remediation approach is neither practicable nor feasible, and in consideration of the uncertainty surrounding its ultimate effectiveness at achieving ARARs within a reasonable time frame and the presence of off-site sources and poor regional groundwater quality, the $400 and $900 million cost of this approach is unwarranted.

SECTION 8

References

CH2M HILL, 2007. Characterization of Cinder/Ash and Reddish-Purple Soils—Field Work Summary and Analytical Results Discussion. September.

CH2M HILL. 2008a. Final Remedial Investigation Report. Quanta Resources Superfund Site. Operable Unit 1. August.

CH2M HILL. 2010a. Draft Final Supplemental Remedial Investigation Report. Quanta Resources Superfund Site. Operable Unit 1. June.

CH2M HILL. 2010b. Draft Final Feasibility Study Report, Quanta Resources Superfund Site, Operable Unit 1. July.

Cohen, R.M., and J.W. Mercer. 1993. DNAPL Site Evaluation, C.K. Smokey. *EPA/600/R-93/022*. February.

Eberhardt, D., and P. Grathwohl. 2002. Time scales of organic contaminant dissolution from complex source zones: coal tar pools vs. blob. Journal of Contaminant Hydrology, 59:45-66.

EPA. 1980. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 121(d)(4)(C). December.

EPA. 1991. A Guide to Principal Threat and Low Level Threat Wastes. *Superfund Publication 9380.3-06FS.* Office of Solid Waste and Emergency Response. November.

EPA. 1993. "Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration." *OSWER Directive 9234.2-25.* September.

EPA. 2000. A Resource for MGP Site Characterization and Remediation: Expedited Site Characterization and Source Remediation at Former Manufactured Gas Plant Sites, Office of Solid and Emergency Response, Technology Innovation Office. *EPA-542-R-00-005.*

EPA. 2002. Maximum Contaminant Levels from Primary Drinking Water Regulations Available at http://www.epa.gov/safewater/ contaminants/index.html#primary.

EPA. 2003. "The DNAPL Remediation Challenge: Is There a Case for Source Depletion?" *EPA/600/R-03/143*. December.

Frind, E.O., J. Molson, and M. Schirmer. 1999. Dissolution and mass transfer of multiple organics under field conditions: the Borden emplaced source. Water Resour. Res., 35(3):683-694.

GZA (GZA GeoEnvironmental, Inc.). 2008. Revised Remedial Action Work Plan, i.Park Edgewater, 45 River Road, Edgewater, New Jersey. ISRA Cases #E20030062 and #E20040267. June.

Hayes, T.D., D.G. Linz, D.V. Nakles, and A.P. Leuschner. 1996. *Management of Gas Plant Sites*. Amherst Scientific Publishers, Amherst, Massachusetts.

Hoffman, Timothy F. 2008. "Hudson River Salt Front Report, April 1 Through September 30, 2007." *United States Geological Survey.*

NJDEP. 1998. Revised Guidance Document for the Remediation of Contaminated Soils. Available at http://www.state.nj.us/dep/srp/regs/soilguide/.

NJDEP. 2004. Safe Drinking Water Act Regulations, N.J.A.C. 7:10. Adopted November 4, 2004. Available at http://www.state.nj.us/dep/watersupply/sdwarule.pdf. Accessed December 29, 2009.

NJDEP. 2005. Federal and New Jersey State Primary and Secondary Drinking Water Standards. http://www.state.nj.us/dep/watersupply/standard.htm. Accessed June 17, 2010.

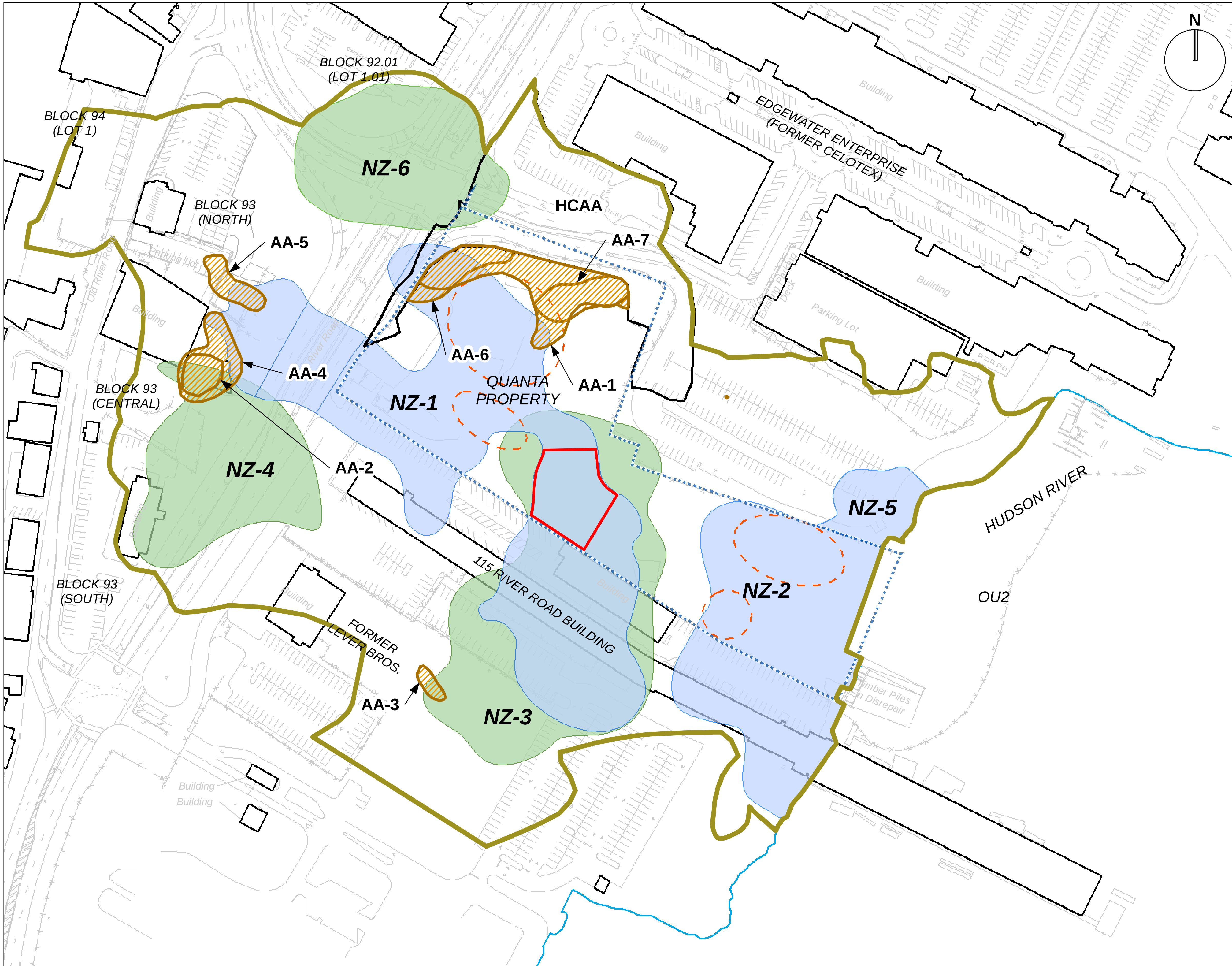
NJDEP. 2007. Well Construction and Maintenance; Sealing of Abandoned Wells, N.J.A.C. 7:9D. April.

Parsons. 2005. Remedial Investigation/Feasibility Study Work Plan, Operable Unit 1, Quanta Resources Site, Edgewater, New Jersey. May.

Stanford, S.D., 1993. Surficial Geologic Map of the Hackensack Quadrangle, Bergen and Passaic Counties, New Jersey. 1993.

Traykovski, Peter, R. Geyer, and C. Sommerfeld. 2004. Rapid Sediment Deposition and Fine-Scale Strata Formation in the Hudson Estuary, *Journal of Geophysical Research, 109.*

Figures



LEGEND

- Existing Arsenic Liner
- Principal Threat Arsenic Area
- Principal Threat NAPL Zone
- Low Level Threat NAPL Zone
- Area of Stacked NZ-1 and NZ-3
- Extent of OU1
- Tar Boils

Notes:

1. Source material is defined based on criteria derived from A Guide to Principal Threat and Low Level Threat Wastes. (EPA, 1991)
2. NZ = NAPL Zone, AA = Arsenic Area
3. Depth of NAPL Zones:
   - NZ-1: 1-11 ft bgs
   - NZ-2: 4-25 ft bgs
   - NZ-3: 15-25 ft bgs
   - NZ-4: 10-32 ft bgs
   - NZ-5: 10-25 ft bgs
   - NZ-6: 10-15 ft bgs
4. Depth of Arsenic Areas:
   - AA-1: 15 ft bgs
   - AA-2: 5 ft bgs
   - AA-3: 7 ft bgs
   - AA-4: 2 ft bgs
   - AA-5: 2 ft bgs
   - AA-6: 2 ft bgs
   - AA-7: 2 ft bgs

0 70 140 ft.

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SOURCE MATERIAL

Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey

May 27, 2010 | **FIGURE 2-1**

\\LAKEFRONT\PROJ\GIS\HONEYWELL\QUANTA\REPORTS\363725_QUANTA_2008FS_REPORT\MAPFILES\FINAL_FS_DELIVERABLE_2010\SECTION_4_PLANVIEWS\REVISED_052010\ES-01_QUANTAOU1_SOURCEMATERIAL.MXD MPETERSH 5/25/2010 11:58:39

Contaminant Characteristics

Generalized Remediation Difficulty Scale

Increasing Difficulty →

Description of Site-Specific Conditions

Category	Contaminant Characteristics	Lower Difficulty	Higher Difficulty	Description of Site-Specific Conditions
Historical Site Use	Nature of Release	Small Volume Short Duration Slug Release	Large Volume Long Duration Continual Release	**Long continual release between late 1800s and the 1980s**
Chemical Properties	Biotic/Abiotic Decay Potential	High	Low	**Abundance of low decay-potential PAHs, non-PAH SVOCs and metals**
Chemical Properties	Volatility	High	Low	**Abundance of low volatility PAHs, non-PAH SVOCs and metals**
Chemical Properties	Contaminant Retardation (Sorption) Potential	Low	High	**Abundance of high sorption-potential PAHs, non-PAH SVOCs and metals**
Contaminant Distribution	Contaminant Phase	Aqueous, Gaseous — Sorbed — LNAPLs	DNAPLs	**DNAPL**
Contaminant Distribution	Volume of Contaminated Media	Small	Large	**Large volume of material spanning 24 acres**
Contaminant Distribution	Contamination Depth	Shallow	Deep	**Material extends to depths of over 30 feet below grade**

Hydrogeologic Characteristics

Category	Characteristic	Lower Difficulty	Higher Difficulty	Description of Site-Specific Conditions
Geology	Stratigraphy	Simple Geology	Complex Geology	**Interbedded and undulating stratigraphy with discontinuous deposits**
Geology	Texture of Unconsolidated Deposits	Sand	Clay	**Sands, silts and clays with discontinuous peat deposits**
Geology	Degree of Heterogeneity	Homo-geneous	Hetero-geneous	**Heterogeneous**
Hydraulics / Flow	Hydraulic Conductivity	High(<10-2 cm/sec)	Low (<10-4 cm/sec)	**Low permeability materials such as silts and clays and peat**

Additional Site-Setting Characteristics

Category	Characteristic	Lower Difficulty	Higher Difficulty	Description of Site-Specific Conditions
Current Site Use	Site Setting	Rural Setting (minimal infrastructure)	Urban Setting (extensive infrastructure)	**Urban setting with significant surficial and subsurface infrastructure**

Key:

Indicates Conditions at the High-end of the Remediation Difficulty Scale are Present (solid circle)

Indicates Conditions trending towards the High-end of the Remediation Difficulty Scale are Present (dotted circle)

Notes:
Generalized Remediation Difficulty Scale adapted from Figure 1 of EPA's Guidance for Evaluating the Technical Impracticability of Ground-water Restoration (*OSWER Directive 9234.2-25.* September 1993).

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Site-Specific Factors Affecting Groundwater Restoration Potential

Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey

March 29, 2010 | **FIGURE 3-1**

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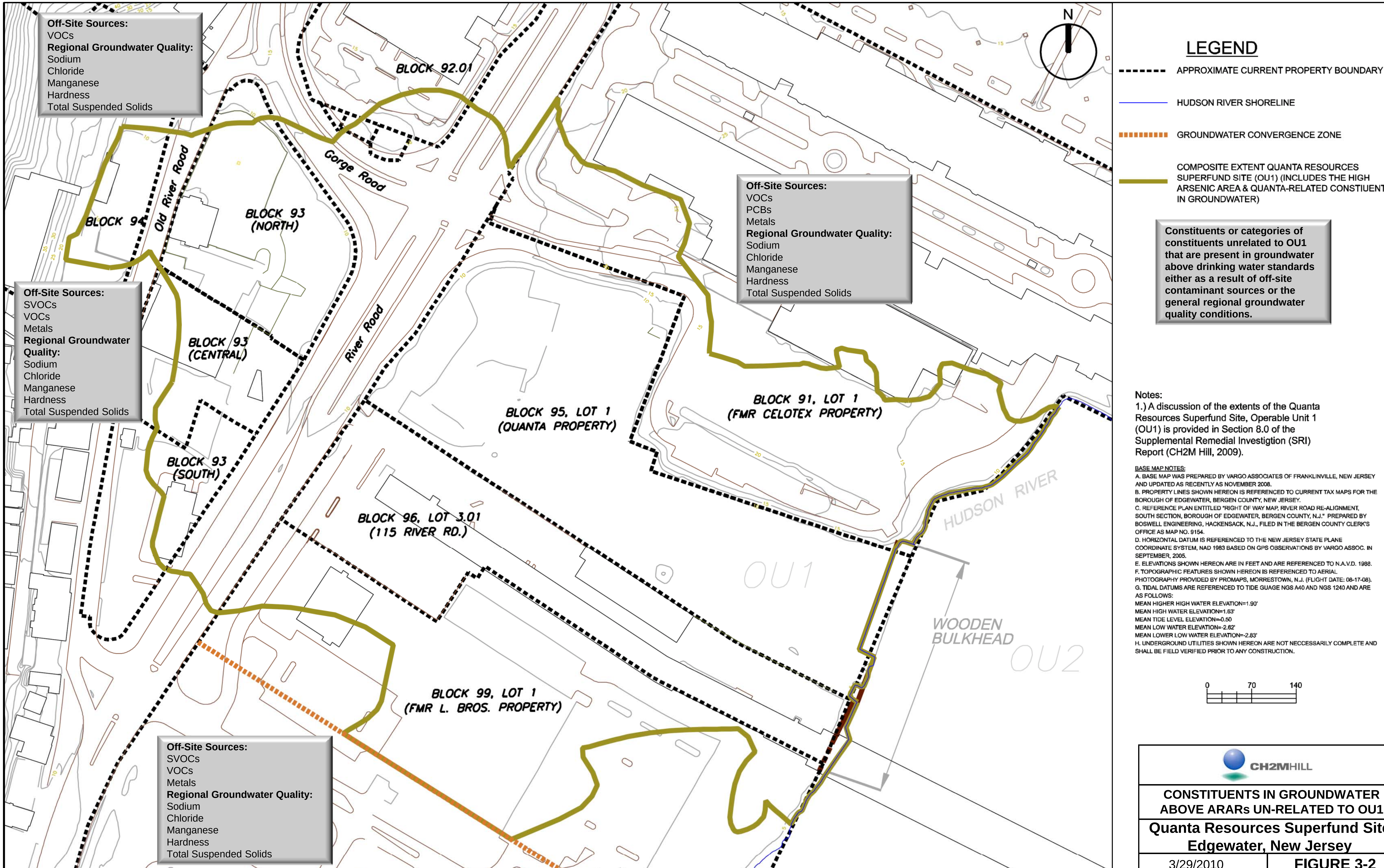

Off-Site Sources:
VOCs
Regional Groundwater Quality:
Sodium
Chloride
Manganese
Hardness
Total Suspended Solids
BLOCK 92.01
Gorge Road
Old River Road
BLOCK 94
BLOCK 93 (NORTH)
BLOCK 93 (CENTRAL)
BLOCK 93 (SOUTH)
River Road
Off-Site Sources:
SVOCs
VOCs
Metals
Regional Groundwater Quality:
Sodium
Chloride
Manganese
Hardness
Total Suspended Solids
Off-Site Sources:
VOCs
PCBs
Metals
Regional Groundwater Quality:
Sodium
Chloride
Manganese
Hardness
Total Suspended Solids
BLOCK 95, LOT 1 (QUANTA PROPERTY)
BLOCK 91, LOT 1 (FMR CELOTEX PROPERTY)
BLOCK 96, LOT 3.01 (115 RIVER RD.)
BLOCK 99, LOT 1 (FMR L. BROS. PROPERTY)
HUDSON RIVER
OU1
OU2
WOODEN BULKHEAD
Off-Site Sources:
SVOCs
VOCs
Metals
Regional Groundwater Quality:
Sodium
Chloride
Manganese
Hardness
Total Suspended Solids
N
LEGEND
APPROXIMATE CURRENT PROPERTY BOUNDARY
HUDSON RIVER SHORELINE
GROUNDWATER CONVERGENCE ZONE
COMPOSITE EXTENT QUANTA RESOURCES SUPERFUND SITE (OU1) (INCLUDES THE HIGH ARSENIC AREA & QUANTA-RELATED CONSTIUENTS IN GROUNDWATER)
Constituents or categories of constituents unrelated to OU1 that are present in groundwater above drinking water standards either as a result of off-site contaminant sources or the general regional groundwater quality conditions.
Notes:
1.) A discussion of the extents of the Quanta Resources Superfund Site, Operable Unit 1 (OU1) is provided in Section 8.0 of the Supplemental Remedial Investigtion (SRI) Report (CH2M Hill, 2009).
BASE MAP NOTES:
A. BASE MAP WAS PREPARED BY VARGO ASSOCIATES OF FRANKLINVILLE, NEW JERSEY AND UPDATED AS RECENTLY AS NOVEMBER 2008.
B. PROPERTY LINES SHOWN HEREON IS REFERENCED TO CURRENT TAX MAPS FOR THE BOROUGH OF EDGEWATER, BERGEN COUNTY, NEW JERSEY.
C. REFERENCE PLAN ENTITLED "RIGHT OF WAY MAP, RIVER ROAD RE-ALIGNMENT, SOUTH SECTION, BOROUGH OF EDGEWATER, BERGEN COUNTY, N.J." PREPARED BY BOSWELL ENGINEERING, HACKENSACK, N.J., FILED IN THE BERGEN COUNTY CLERK'S OFFICE AS MAP NO. 9154.
D. HORIZONTAL DATUM IS REFERENCED TO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD 1983 BASED ON GPS OBSERVATIONS BY VARGO ASSOC. IN SEPTEMBER, 2005.
E. ELEVATIONS SHOWN HEREON ARE IN FEET AND ARE REFERENCED TO N.A.V.D. 1988.
F. TOPOGRAPHIC FEATURES SHOWN HEREON IS REFERENCED TO AERIAL PHOTOGRAPHY PROVIDED BY PROMAPS, MORRESTOWN, N.J. (FLIGHT DATE: 08-17-08).
G. TIDAL DATUMS ARE REFERENCED TO TIDE GUAGE NGS A40 AND NGS 1240 AND ARE AS FOLLOWS:
MEAN HIGHER HIGH WATER ELEVATION=1.90'
MEAN HIGH WATER ELEVATION=1.63'
MEAN TIDE LEVEL ELEVATION=-0.50
MEAN LOW WATER ELEVATION=-2.62'
MEAN LOWER LOW WATER ELEVATION=-2.83'
H. UNDERGROUND UTILITIES SHOWN HEREON ARE NOT NECCESSARILY COMPLETE AND SHALL BE FIELD VERIFIED PRIOR TO ANY CONSTRUCTION.
0
70
140
CH2MHILL
CONSTITUENTS IN GROUNDWATER ABOVE ARARs UN-RELATED TO OU1
Quanta Resources Superfund Site
Edgewater, New Jersey
3/29/2010
FIGURE 3-2

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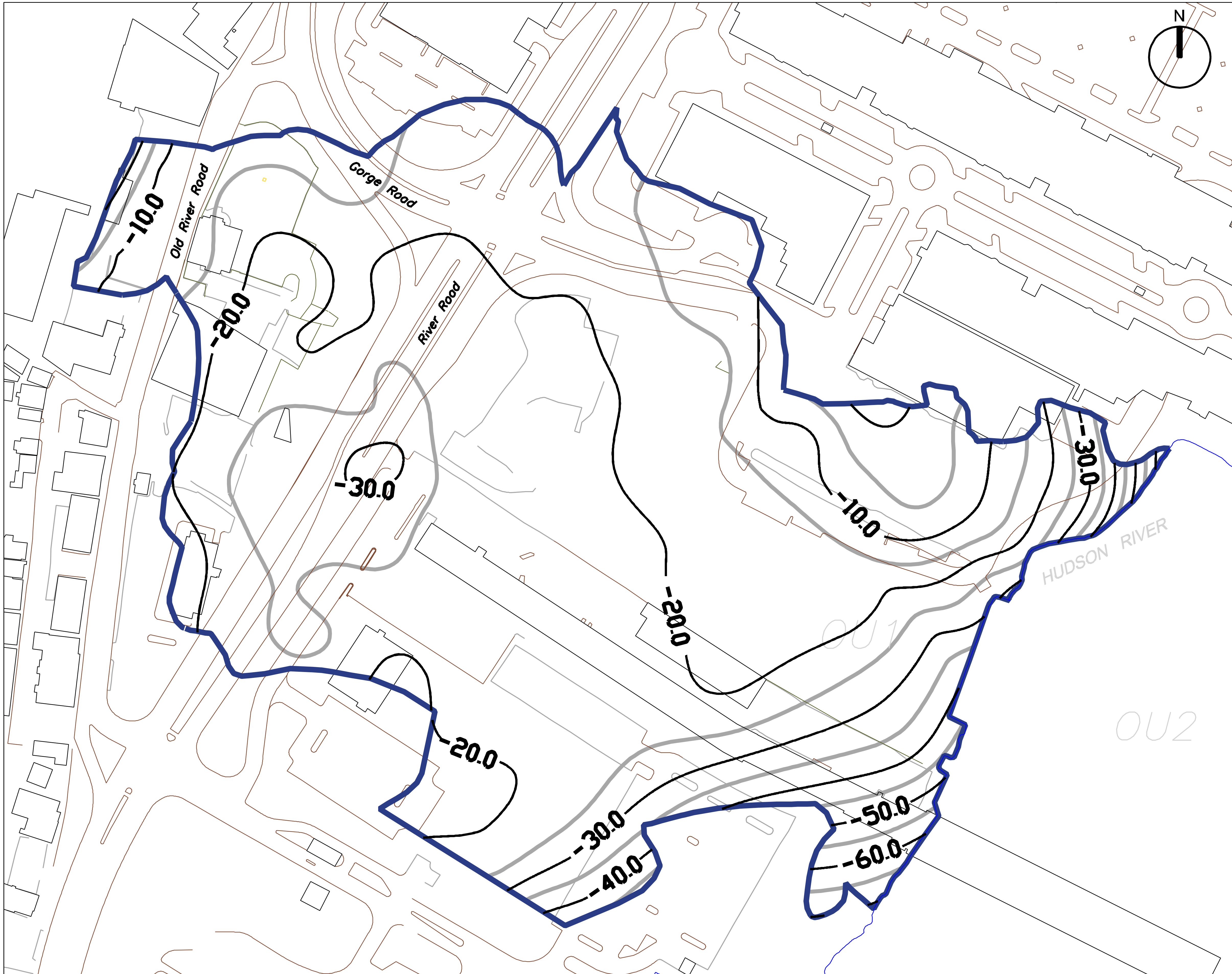

LEGEND

- APPROXIMATE CURRENT PROPERTY BOUNDARY
- HUDSON RIVER SHORELINE
- LATERAL EXTENT OF GROUNDWATER ABOVE THE SILTY-CLAY AND/OR BEDROCK SURFACE REQUIRING A TECHNICAL IMPRACTICABILITY (TI) WAIVER
- 5 FOOT ELEVATION CONTOUR FOR THE BASE OF THE TI WAIVER FOR GROUNDWATER
- 10 FOOT ELEVATION CONTOUR FOR THE BASE OF THE TI WAIVER FOR GROUNDWATER

NOTES:
1.) THE LOWER ELEVATION OF THE TECHNICAL IMPRACTICABILITY (TI) AREA FOR GROUNDWATER AS CONTOURED HERE REPRESENTS AN ELEVATION EQUAL TO A DEPTH OF FIVE FEET BELOW THE SURFACE OF THE SILTY-CLAY CONFINING UNIT OR THE BEDROCK SURFACE, WHICHEVER IS SHALLOWER.

BASE MAP NOTES:
A. BASE MAP WAS PREPARED BY VARGO ASSOCIATES OF FRANKLINVILLE, NEW JERSEY AND UPDATED AS RECENTLY AS NOVEMBER 2008.
B. PROPERTY LINES SHOWN HEREON IS REFERENCED TO CURRENT TAX MAPS FOR THE BOROUGH OF EDGEWATER, BERGEN COUNTY, NEW JERSEY.
C. REFERENCE PLAN ENTITLED "RIGHT OF WAY MAP, RIVER ROAD RE-ALIGNMENT, SOUTH SECTION, BOROUGH OF EDGEWATER, BERGEN COUNTY, N.J." PREPARED BY BOSWELL ENGINEERING, HACKENSACK, N.J., FILED IN THE BERGEN COUNTY CLERK'S OFFICE AS MAP NO. 9154.
D. HORIZONTAL DATUM IS REFERENCED TO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD 1983 BASED ON GPS OBSERVATIONS BY VARGO ASSOC. IN SEPTEMBER, 2005.
E. ELEVATIONS SHOWN HEREON ARE IN FEET AND ARE REFERENCED TO N.A.V.D. 1988.
F. TOPOGRAPHIC FEATURES SHOWN HEREON IS REFERENCED TO AERIAL PHOTOGRAPHY PROVIDED BY PROMAPS, MORRESTOWN, N.J. (FLIGHT DATE: 08-17-08).
G. TIDAL DATUMS ARE REFERENCED TO TIDE GUAGE NGS A40 AND NGS 1240 AND ARE AS FOLLOWS:
MEAN HIGHER HIGH WATER ELEVATION=1.90'
MEAN HIGH WATER ELEVATION=1.63'
MEAN TIDE LEVEL ELEVATION=-0.50
MEAN LOW WATER ELEVATION=-2.62'
MEAN LOWER LOW WATER ELEVATION=-2.83'
H. UNDERGROUND UTILITIES SHOWN HEREON ARE NOT NECCESSARILY COMPLETE AND SHALL BE FIELD VERIFIED PRIOR TO ANY CONSTRUCTION.

0 70 140

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TECHNICAL IMPRACTICABILITY BOUNDARY FOR GROUNDWATER

Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey

March 29, 2010

FIGURE 6-1

FILENAME: CH-Quanta_TIWaiverExtents-2010.02.dgn PLOT DATE: 3/29/2010 PLOT TIME: 3:36:25 PM

Appendix A
Definitions

Definitions used throughout this document include the following:

Quanta Resources Superfund Site. As defined in the AOC II-CERCLA-2003-2012, the Quanta Resources Superfund Site includes "the former Quanta Resources Site and any areas where contamination from the Site has come to be located." The Site consists of two operable units, OU1 and OU2. The boundary of OU1 was updated as part of the Draft Final Supplemental Remedial Investigation (SRI) report (CH2M HILL, 2010a).

Quanta Property. The land portion of Block 95, Lot 1, in Edgewater, New Jersey.

Former Quanta Resources Property. The land portion of Block 95, Lot 1, and Block 93, Lot 1, as well as the portion of River Road between these lots.

Former Barrett Property. The maximum extent of Barrett Manufacturing Company operations as depicted on historical Sanborn® fire insurance maps included in the OU1 RI report (CH2M HILL, 2008a).

Former Celotex Property (City Place). The land portion of Block 91, Lot 1 (north of the Quanta property).

Former Acid Plant. A chemical plant that produced acids, alums, sodium compounds, and sulfuric acid (Parsons, 2005) at the former Celotex property and the northwest portion of the current Quanta property from at least 1900 until 1957.

115 River Road Property. The land portion of Block 96, Lot 3.01 (south of the Quanta property).

Former Lever Brothers Property (i.Park property). The land portion of Block 99, Lots 1, 3, and 4 (south of the 115 River Road property).

Block 93. Three separate properties west of River Road:

- Block 93 North, which consists of Lot 1, the northern portion of Lot 2, and Lot 3
- Block 93 Central, which consists of Lots 1.01, 3.03, and 3.04, and the southern portion of Lot 2
- Block 93 South, which consists of Lots 1.02 and 4

Block 94. Block 94, Lot 1, which is west of Block 93 and Old River Road.

NAPL. Non–aqueous phase liquid, or "product." NAPL can exist as a single chemical component or as a mixture of several, and it can exist in soils in free-phase or residual states. Free-phase NAPL moves under the force of gravity and hydraulic forces. Residual NAPL is defined as being immobile when soil capillary forces are greater than gravity and hydraulic forces (Cohen and Mercer, 1993). In this report, the term "NAPL" refers to both free-phase and residual states, unless otherwise noted.

LNAPL. Light non–aqueous phase liquid. LNAPL has a density less than 1.0.

DNAPL. Dense non–aqueous phase liquid. DNAPL has a density greater than 1.0.

Coal Tar. Material characterized by a complex and variable mixture of compounds, typically complex high-molecular-weight hydrocarbons and other byproducts from former manufactured-gas plant operations (Hayes et al., 1996; EPA, 2000). At the site, coal tar was delivered to the former Barrett property for use by the Barrett Manufacturing Company's Shadyside[1] Plant for production of roofing paper and other materials.

Tar Boils. Solid, black, soft-to-stiff, semiplastic-to-plastic tar in the near-surface vadose zone that has been observed to seep upward to the ground surface through cracks in soil or pavement on very hot days (around 90°F). Once the tar reaches the surface, it either forms a bubble or spreads out laterally in thin layers within the preexisting, hardened tar (from past heating events).

COI. Constituent of interest.[2] A constituent present at concentrations exceeding one or more state or federal screening criteria.

COC. Constituent of concern. Constituent present at concentrations exceeding calculated acceptable risk ranges in the Ecological and Human Health Risk Assessments.

Source Material. Material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of constituents to groundwater, to surface water, or to air, or act as a source for direct exposure (EPA, 1991).

High-Concentration Arsenic Area. The high-concentration arsenic area (HCAA) is defined by the extent of the impermeable arsenic liner on the former Celotex property, which was originally designed and built to cover concentrations of arsenic in soil in excess of 1,000 mg/kg.

Principal Threat Waste. Source material considered highly toxic or highly mobile that generally cannot be reliably contained and that would present a significant potential risk to human health or the environment should exposure occur (EPA, 1991). "Highly mobile" refers to source material that is not reliably contained and has a significant potential to migrate to surface water, to sediments, or to air or to act as a source for direct exposure. Highly toxic source material represents a significant potential risk based on the characteristics of the material and based on the exposure potential of the material (e.g., greater than 10^{-3} excess lifetime cancer risk, or ELCR).

Low-Level Threat Waste. Source material that generally can be reliably contained and that would present only a low-level potential risk in the event of release. It includes source

[1] The Town of Edgewater was formerly known as Shadyside, New Jersey.

[2] COIs were identified in the RI Report (CH2M HILL, 2008a) by screening analytical results against the lowest available soil and groundwater screening criteria from among the 2004 EPA Region 9 PRGs (residential soil, industrial soil, and groundwater), proposed New Jersey soil cleanup criteria (residential, nonresidential, and impact-to-groundwater) (New Jersey Administrative Code [NJAC] 7-26D), and promulgated New Jersey groundwater quality criteria (or interim generic values (NJAC 7:9-6). In the follow-up draft SRI Report (CH2M HILL, 2009a), COIs were identified as above, with the exception that replaced or revised screening criteria were used where appropriate. Specifically, NJDEP promulgated residential and nonresidential soil cleanup criteria and eliminated the impact-to-groundwater soil-cleanup criteria in June 2008. For several constituents, the promulgated residential or nonresidential standard had been revised from the value presented in the draft criteria. The 2004 EPA Region 9 Preliminary Remediation Goals were replaced in September 2008 by the EPA Regional Screening Levels for Chemical Contaminants at Superfund Sites. SRI groundwater data was also screened against EPA Maximum Contaminant Levels for drinking water (EPA, 2002).

materials that exhibit low toxicity or low mobility in the environment, or are near health-based levels.[3]

Residual Soil. Soil within the boundary of OU1 that contains constituents at concentrations exceeding one or more PRGs but not considered principal threat waste or source material.

[3] OSWER Directive 9380.3-06FS (EPA, 1991).

Appendix B
Detailed Conceptual Site Model

Detailed Conceptual Site Model

1. Site Background and History

Constituents associated with former Site operations have been observed in parts of the following areas, which together make up OU1:

- Block 95, Lot 1 (the Quanta property)
- Block 91, Lot 1 (the former Celotex property)
- Block 96, Lot 3.01 (the 115 River Road property)
- Block 99, Lot 1 (the former Lever Brothers property)
- River and Gorge Roads
- Block 93 (north, central, and south)
- Block 94, Lot 1
- Block 92.01 (north of Gorge Road)

The total land area of OU1 encompasses approximately 24 acres. OU1 includes the observed extent of Site-related NAPL and constituents detected in soil and groundwater related to former operations, plus the HCAA. A tidally influenced mud flat–marsh associated with the Hudson River borders OU1 immediately to the east of the wooden bulkhead. These river sediments, which consist of silt to clayey silt greater than 50 ft thick and the surface water compose OU2 and are being evaluated and addressed under a separate Administrative Order on Consent (AOC).

Prior to the mid-1800s, the Site and surrounding areas were tidal marshlands associated with the Hudson River. Development of rail lines and industry along the banks of the Hudson River prompted the systematic filling in of these marshlands. Fill material during this timeframe is known to have contained coal, coal ash, wood ash, cinder, and slag. This fill material contains varying concentrations of polycyclic aromatic hydrocarbons (PAHs), arsenic, and other metals in concentrations that often exceed regulatory soil cleanup criteria and contribute to the presence of constituents in groundwater.

From approximately 1872 to 1971, a large portion of the Site was used to process coal tar and to produce paving and roofing materials.

The former Celotex property, to the north, has been the site of a chemical plant, a gypsum company, a vacuum truck company, and a metal reclaiming/refinishing plant. The chemical plant, General Chemical Company, operated on the southern portion of the property from at least 1900 until 1957. The chemical plant was used to produce acids, alums, sodium compounds, and sulfuric acid (Parsons, 2005). In 1974, a portion of the Site was reoccupied and leased for oil recycling, which continued until New Jersey Department of Environmental Protection (NJDEP) stopped all activities in 1981 when it discovered that storage tanks contained waste oil contaminated with polychlorinated biphenyls (PCBs). Afterward, aboveground and underground storage tanks were removed, and the site has remained vacant since.

2. Physical Setting

Geology

Soil impacted by former Site operations consists predominantly of fill material and deposits of native sand, peat, and organic silt in contact with shallow groundwater. The characteristics of the stratigraphic units at the Site are described below, in order of shallowest to deepest.

- **Fill material.** Up to 35 ft of fill material consisting of a mixture of gravel, sand, and silt with brick, wood, concrete fragments, coal, cinders, and slag.
- **Peat/clayey peat.** Up to 25 ft of organic peat or "meadow mat" with varying amounts of clay, fine sand, and silt. This unit is the "salt marsh peat" that is present in portions of the estuarine and salt marsh deposits depicted by Stanford (1993). The peat/clayey peat deposits are discontinuous and have been observed primarily in borings completed in western portions of the Site near River Road, Block 93, and the former Lever Brothers property.
- **Soft organic silt.** Up to 68 ft of soft gray-to-black organic silt containing wood, roots, and shell fragments. This unit is also included in the estuarine and salt marsh deposits (Stanford, 1993). The soft organic silt is typically present only within 100 ft of the shoreline throughout the entire study area and represents former river sediments that were buried during shoreline filling. It pinches out to the west near MW-7 and against the bedrock high to the northwest between MW-C and MW-O on the City Place property.
- **Shallow native sand.** Up to 21.5 ft of fine to medium/coarse sand with varying amounts of gravel and fines. In the central portions of the Quanta property and the northern portion of the i.Park property where the peat/clayey peat and soft organic silt are absent, the shallow native sand resides directly beneath the fill unit.
- **Silty clay (confining unit).** Up to 35 ft of continuous silty clay with varying amounts of fine sand. The silty clay represents a lake-bottom unit that underlies the estuarine and salt marsh deposits (Stanford, 1993). The silty clay serves as a confining unit and an aquitard between both the overlying native sand and fill units and the underlying deep sand deposits. It is found across most of the site with an undulating surface that dips eastward in close proximity to the existing shoreline and pinches out towards the north against a bedrock high at City Place property.
- **Deep sand.** Up to approximately 32 ft of fine to coarse sand, sand with varying amounts of silt and clay, and silt and clay with varying amounts of sand. The deep sand represents a lacustrine fan unit that lies beneath the confining silty clay unit (Stanford, 1993). Like the overlying silty clay confining unit, the deep sand dips eastward under the Hudson River and pinches out towards the north against the bedrock high present on City Place property and to the west against the rising Palisades ridge.
- **Till.** Up to 12 ft of a very dense, low permeability, reddish-brown to reddish-yellow silty sand and sand with gravel, cobbles, and boulders. Borings at MW-135, PZ-6, PZ-7, BH-1, and BH-2 confirmed the presence of the till unit during the SRI (CH2M HILL, 2010a).

Till is present at locations across the Site, including MW-116DS, MW-101DS, MW-103DS, MW-107DS, GZA-90, SS-24C, and SS-25A. During the SRI it was also observed at MW-127, located on the western edge of Block 93 Central, and at MW-128 and MW-129 at Block 94 close to the Palisades ridge.

- **Bedrock.** As noted in the RI report (CH2M HILL, 2008a, Appendix A), the Stockton Formation composes the underlying bedrock formation at the Site and is found at depths ranging from 8.5 to 86 ft bgs. A bedrock high is present in the south-central portion of the City Place property, with bedrock present as shallow as 8.5 ft bgs and generally no more than 10 to 12 ft bgs. Towards the east and southeast bedrock dips dramatically forming the Hudson River channel.

Hydrogeology

Although historical groundwater flow paths may have differed from those observed during the remedial investigation (RI) and the SRI, the direction of the shallow unconfined groundwater flow is generally to the east and south, with an area of radial flow on the Quanta property. Evaluation of groundwater elevation data indicates that the direction of the shallow groundwater is predominately to the southeast, under an average hydraulic gradient of 0.0068 ft/ft during low-tide conditions and 0.0066 ft/ft during high-tide conditions. Flow direction remains consistent between daily tidal events (low and high tides); however, the hydraulic gradient is slightly steeper during low-tide conditions.

A tidal response has been observed in monitoring wells adjacent to the Hudson River north and south of the area of the wooden bulkhead, which impedes groundwater flow on the Quanta property. Leakage has been observed across the bulkhead during low tide. In addition, lower hydraulic heads at select wells adjacent to the bulkhead and indications of groundwater upwelling in sediments suggest groundwater leakage may be occurring across the structure. However, a geophysical survey has indicated that, below the water table and mean surface water level, the bulkhead’s boards are relatively competent.

Most groundwater at the shoreline flanks the bulkhead to the north and south before moving into the sediments at OU2 and eventually upwelling to the surface water at OU2 in zones of preferential discharge identified during the SRI. Tidal influences on the shallow and deep sand hydrostratigraphic units decrease westward from the Hudson River.

The radial groundwater flow pattern in shallow unconfined groundwater is the result of localized recharge associated with low-lying unpaved areas in the central portion of the Quanta property, where less-permeable peat deposits slow the percolation of rainwater. The wooden bulkhead impedes groundwater flow to the Hudson River from OU1, along with the bedrock high at the former Celotex property, driving a southerly component to flow.

South of the Site, an area of groundwater convergence has been observed consistently near the central to northern portion of the former Lever Brothers property. At this location, shallow unconfined groundwater from the central portions of the former Lever Brothers property flows to the northeast and converges with groundwater flowing from the Quanta property and from Block 93. This interpretation has been confirmed by data collected as part of environmental investigations at the former Lever Brothers property (GZA, 2008).

Hydrology

Although OU2 is being investigated pursuant to a separate AOC, mitigating any risk posed by potential constituent flux from groundwater (OU1) to surface water (OU2) is a critical element of remedial goal development for OU1. The presence of a wooden bulkhead along the shoreline largely affects groundwater flow to OU2. Although this structure impedes groundwater flow, causing groundwater flowing eastward to flow north and south once it reaches the shoreline, flow does occur across it to some degree, particularly in the southern end and at discrete areas along its length. Once groundwater moves from OU1 to OU2, it is driven upward through the sediments and discharges to surface water at OU2. Areas of potential groundwater upwelling have been identified in OU2 north of and immediately east of the bulkhead along the shoreline. Further south, beyond the bulkhead, upward forces of groundwater flow are not as pronounced. In this area, vertical gradients are more subdued and generally flat, and groundwater discharge is believed to occur slightly farther offshore.

3. Nature and Extent

The primary risk drivers at the site are carcinogenic PAHs, naphthalene, and arsenic. Along with these primary risk drivers, surficial tar boils are presumed to pose an unacceptable risk. A total of 15 delineated areas within OU1 (NZ-1 through -6, the tar boils, HCAA, and AA-1 through -7) were evaluated as part of the Draft Final FS report (CH2M HILL, 2010b), and all were found to represent source material as defined by EPA (1991) guidance. Each of the 15 areas represents a source to groundwater contamination, as does residual contamination throughout OU1 outside the 15 delineated areas. The nature and extent of these 15 source areas are summarized in the following subsections.

Nature and Extent of NAPL and Solid Tar

The location, nature, and extent of free and residual NAPL at OU1 have been well characterized using extensive analytical data and field observations as well as TarGOST® laser-induced fluorescence screening data. Residual and free-phase NAPL occur in shallow soils in discrete areas above the silty clay confining layer that generally correspond with locations of former primary sources (e.g., historic tank farms). Impacts extend beyond the lateral extent of NAPL in the form of staining or odors, as shown in Figure 2-1 of the Technical Impracticability Evaluation, and as adsorbed and dissolved-phase aromatic volatile and semivolatile organic compounds (VOCs and SVOCs; predominantly PAHs) in soil and groundwater.

NAPL is present primarily in the form of residual and free-phase DNAPL, which is denser than water. Depictions of NAPL show that its distribution is consistent with the locations of former tanks depicted in historical maps (CH2M HILL, 2010a). NAPL is present in shallow soils in discrete discontinuous areas within and above the silty clay confining layer overlying the deep sand unit or in the fill, native sand, or organic silt above the bedrock high to the north where the silty clay is not present. NAPL has accumulated in natural depressions in the surface of the silty clay confining unit or the surface of the shallower peat deposits to the west, except in those areas where it remains hung up around the water table due to elevated viscosities and interfacial tensions preventing further downward migration.

The extent of solid tar has been defined through field observations. Solid tar has also been observed within the fill at a number of locations across the Site, most frequently in the form of a black, soft to stiff, semiplastic to plastic material. A detailed description of the nature and extent constituents is included in the Draft Final SRI report (CH2M HILL, 2010a). Most occurrences of solid tar have been observed in the fill deposits at the Quanta property and to the west, at Block 93 North at discrete depth intervals, with a thickness ranging from 0.3 ft to approximately 6 ft. Based on field investigations conducted to date at the Site, surficial tar boils typically coincide with areas where solid tar has been observed within the shallow fill.

Chemical Composition of NAPL

With the exception of LNAPL at MW-7 on the former Lever Brothers property,[1] NAPL samples collected were identified through chemical analysis as consisting, at least partially, of coal tar. The most common SVOCs detected in NAPL samples from the Site were naphthalene, phenanthrene, 2-methylnaphthalene, and C1-phenanthrenes/anthracenes. Overall, naphthalene is the most common PAH detected in the NAPL samples. VOCs detected in NAPL samples included 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, benzene, ethylbenzene, isopropylbenzene, naphthalene, n-propylbenzene, p-isopropyltoluene, styrene, toluene, and xylene.

Physical Properties of NAPL

Variances in the physical properties of the NAPL samples suggest that they have varying degrees of mobility in the subsurface under current conditions. With the exception of the NAPL detected to the south at monitoring well MW-107 and to the north along the shoreline at MW-135, the NAPL at OU1 has relatively elevated measured viscosity and interfacial tension, indicating a lower propensity to migrate.

Extent of NAPL

Extensive characterization has revealed that most NAPL at the Site is present in one of six discrete NAPL zones (NZ-1 through NZ-6). The NAPL zones are depicted in Figure 2-1 of the Technical Impracticability Evaluation. Although the NAPL in each of these zones is composed primarily of coal tar, each zone's NAPL has distinct physical characteristics. NAPL also exists outside these defined zones but is generally characterized by the presence of residual NAPL only, or thin pockets of free-phase NAPL that are not contiguous with the defined NAPL zones.

NAPL is found within the lateral extent of the current Quanta property and extends west across River Road and onto the eastern portions of Block 92.01 and Blocks 93 North, Central, and South. Site-related NAPL also extends southward into the northern and central portions of the former Lever Brothers property. To the east, on the Quanta property, NAPL is found in significant thicknesses adjacent to the wooden bulkhead, from which it appears to have moved laterally to the south and north along this feature in deeper and thinner lenses. South of 115 River Road, along the shoreline, Site-related NAPL appears to be residual only and is close to non-Site-related NAPL and constituents in soil associated with historical operations

[1] As discussed in the RI Report (CH2M HILL, 2008a), LNAPL from MW-7 is considerably different than the NAPL samples in the remaining monitoring wells.

at the former Lever Brothers property. To the north, free-phase NAPL along the shoreline has been found to accumulate within monitoring well MW-135.

NAPL Zone 1. NZ-1 is present in the southern portion of the Quanta property and west beneath River Road into the eastern portions of Blocks 93 North and Central. It extends south into the 115 River Road property and into a limited area along the northern boundary of the former Lever Brothers property. In NZ-1, high viscosity and interfacial tension and the presence of less-permeable meadow mat deposits have generally limited the downward vertical migration of NAPL, confining it to within the fill layer near the water table. Most of NZ-1 is at a depth of approximately 11 ft bgs, with NAPL between 3 and 11 ft east of River Road, and between 1 and 12 ft bgs beneath Blocks 93 North and Central. NAPL is present between 6.5 and 20 ft bgs beneath River Road. In an isolated area (the vicinity of MW-102B and SB-9), NAPL has migrated to the depth of the silty clay confining unit, approximately 23.5 ft bgs, which corresponds to the location of a former coal tar underground storage tank and a localized area of thicker fill deposits.

NAPL Zone 2. NAPL in NZ-2 is present along the Site shoreline, from the northern Quanta property boundary southward, beneath the 115 River Road building, and into portions of the northeast corner of the former Lever Brothers property. It extends approximately 250 ft inland westward and is bound at the east by the shoreline. NAPL at NZ-2 is not homogeneous; it has been found to have varying physical characteristics, which indicates portions of the NAPL have limited potential for migration. NAPL in this zone extends throughout the fill unit and into the upper portions of the organic silt deposits with sporadic occurrences within the underlying till to the north. Its migration has been limited to between approximately 4 and 25 ft bgs; however, the bulk of the NAPL at NZ-2 is above a depth of approximately 15 ft bgs. The wooden bulkhead along the shoreline has impeded the flow of NAPL to OU2, causing it to seep laterally north and south beyond the extents of the bulkhead.

NAPL Zone 3. NZ-3, extending from the central portion of the Quanta property south into the former Lever Brothers property, is beneath NZ-1; it extends laterally beyond the extent of this shallower NAPL zone from a depth of approximately 15 ft bgs to a few feet into the top of the silty clay confining unit at approximately 22 to 25 ft bgs. Due to its lower interfacial tension (8.2 dynes/cm^2) and viscosity (3.49 centistokes (cSt)), NAPL in NZ-3 has migrated downward and laterally to a natural depression in the top of the undulating silty clay confining unit, which is limiting further migration. Its presence as thin, discontinuous lenses southeastward indicates that under current conditions, NAPL at NZ-3 is not migrating beyond the natural depression in the top of the silty clay confining unit.

NAPL Zone 4. NZ-4 consists of NAPL beneath the northwestern portion of the former Lever Brothers property and across River Road into Blocks 93 Central and South. NAPL in NZ-4 is present in two separate layers, one between approximately 10 and 15 ft bgs and the other between approximately 20 and 32 ft bgs. The first lens occurs mostly in the fill layer or into the top few feet of the peat unit. The second lens penetrates the peat near MW-123 but is sporadic and discontinuous. Interfacial tension (16.65 dynes/cm^2) and viscosity (13.1 cSt at 122°F) of this NAPL are similar to that of NAPL in NZ-2 at MW-116B. NAPL saturation in the vicinity of MW-123 is likely elevated, based on the presence of 14.2 ft of NAPL in this well. In all directions along the periphery of NZ-4, a consistent rise in the elevation of the peat and silty clay is present preventing further lateral migration.

NAPL Zone 5. NAPL at NZ-5 is adjacent to the Hudson River in the southeastern portion of the former Celotex property, from the shoreline up to 130 ft inland to the west and 120 ft north of the Quanta/former Celotex property boundary. It is present at depths of up to 40 ft bgs, with the majority residing between 20 and 25 ft bgs, at the interface between the fill and soft organic silt units. The interfacial tension and viscosity of a NAPL sample collected from MW-135 is the lowest for all NAPL samples from the Site, with the exception of NAPL at MW-107 in NZ-3 indicating that it has the potential for mobility. NAPL zones NZ-2 and NZ-5 are connected, with NZ-5 being present as thinner deposits and at lower saturation levels than NAPL behind the bulkhead at NZ-2 to the south. NAPL zones NZ-2 and NZ-5 are at the same elevation although NZ-5 has had approximately 10 ft of fill material and asphalt placed over it during redevelopment of the former Celotex property.

NAPL Zone 6. NAPL Zone 6 comprises NAPL observed at the intersection of Gorge and River Roads, from the northeast corner of Block 93 North, the southwest corner of the former Celotex property, the northwest corner of the Quanta property, and the southeast corner of Block 92.01. It is present at depths ranging from 8.4 to 15 ft bgs just beneath the water table. NAPL observed at a depth of 8.4 ft bgs in a single monitoring well (MW-N1) represents an isolated occurrence not representative of the elevation of the majority of the NAPL found in this zone. Most NAPL in this zone is found at 10 ft bgs. The NAPL remains at least 10 ft above the surface of the silty clay between the fill and underlying native sand or peat. Its failure to accumulate in MW-126, which is screened within the most NAPL-impacted interval observed within NZ-6, suggests that NAPL saturation levels in this area are lower than in other NAPL zones. A natural depression in the silty clay surface in this portion of the Site underlies NZ-6.

Nature and Extent of Constituents in Soil

Constituents detected in soil include aromatic VOCs, SVOCs (predominantly PAHs), and metals (principally arsenic and lead). Constituents detected less frequently above screening criteria within OU1 include chlorinated VOCs, and pesticides.

VOCs and SVOCs

Soil sampling events conducted in and around the Site have indicated the presence of PAHs in unsaturated and saturated soil. PAHs were not detected above screening criteria in soil samples collected from the deep sand unit beneath the silty clay aquitard (i.e., beneath OU1). Exceedances of aromatic VOCs, particularly benzene, in unsaturated soils appear to lie within the extent of the historical Site operations, whereas the extent of benzene in saturated soil extends slightly farther south, outside the footprint of former operations, in the direction of groundwater flow.

In general, the distribution of PAHs, aromatic VOCs, and other NAPL-related constituents (e.g., select non-PAH SVOCs) was observed to be coincident with the presence of NAPL. However, concentrations of PAHs unrelated to former Site operations have also been observed outside these areas. These concentrations are due to the presence of ubiquitous fill material throughout the area and south of OU1 and as a result of historical operations at the former Lever Brothers property.

Chlorinated VOCs were detected intermittently in soil samples—predominantly in saturated soil samples—across the Site during RI and SRI investigation activities. Chlorinated VOCs were detected less frequently in soil at the Quanta property than at the adjacent properties, with the majority of the detections in soils at the former Lever Brothers and former Celotex properties. The infrequent and low-level detections along with the irregular distribution of chlorinated solvents in soil suggest that no known, ongoing, Site-related source of these constituents exists.

Inorganics

The distribution of metals is consistent with areas of former pyrite roasting associated with the former acid plant. However, concentrations of metals unrelated to operations associated with the former acid plant have been observed consistently above screening criteria outside these areas because of the ubiquitous heterogeneous fill containing coal, cinders, and slag.

The extent of elevated arsenic concentrations in soil near the site of the former acid plant has been defined and does not extend beyond the southern portion of the former Celotex property and the northwestern corner of the Quanta property. During the SRI, a separate and much smaller source of elevated metals concentrations exhibiting a pyritic-material signature was identified in the shallow fill in the north-central portion of the former Lever Brothers property. Like other arsenic hotspots at the former Lever Brothers property that are found beyond the extent of OU1, this smaller source of arsenic is unrelated to former operations and is being addressed as part of remedial efforts being performed for this property. With the possible exception of an isolated area of elevated arsenic concentrations adjacent to the Hudson River in the southern part of the former Celotex property elevated arsenic concentrations in soil outside these two pyritic source zones —are associated with isolated hotspots in the heterogeneous anthropogenic fill material. These fill materials also contain concentrations of PAHs above screening criteria.

Beyond the pyritic source zones, the extent and distribution of lead in soil has been defined and is different than that of arsenic (Figures 1-5 and 1-6 of the Draft Final FS Report). The distribution of lead is more widespread at the former Celotex property.

Arsenic Source Areas. The extent of elevated arsenic concentrations in soil near the site of the former acid plant has been defined and does not extend beyond the southern portion of the former Celotex property and northwestern corner of the Quanta property. During the SRI, a separate and much smaller source of elevated metals concentrations exhibiting a pyritic-material signature was identified in the shallow fill in the north-central portion of the former Lever Brothers property. Elevated arsenic concentrations in soil outside these two pyritic source zones have been observed within the heterogeneous anthropogenic fill material that can also contain concentrations of PAHs above screening criteria. These arsenic hot spots are typically an order-of-magnitude less in concentration than the pyritic source zones and are consistent with other smaller areas of arsenic observed in the fill off-Site across the former Lever Brothers property.

Four distinct areas of elevated metals in soil were defined at the Site. Two of these areas (the HCAA and ASA-1) exhibit a pyritic waste signature. A third area (ASA-3), although physically separate from the HCAA, may have resulted from the historic transport of arsenic in groundwater from the HCAA and subsequent repartitioning to soil. The remaining arsenic source area (ASA-2) represents a hot spot within the heterogeneous and ubiquitous fill that was used to initially raise the topographic elevation along the banks of the Hudson River. Mobilization of dissolved arsenic from pyritic source zones is due to the leaching of these acid wastes, whereas reductive dissolution resulting from the increased presence of dissolved organics, including coal tar, and native organics has led to soluble arsenic near hot spots within the saturated fill.

As part of the FS, arsenic in soil was evaluated further based on its risk potential to residents and construction workers. For the residential exposure scenario (0–2 ft bgs), a risk of 10^{-3} corresponds to a soil concentration of 390 mg/kg of arsenic. For the construction worker scenario (0–10 ft bgs), a risk of 10^{-3} corresponds to a soil concentration of 13,000 mg/kg of arsenic. Despite the calculated 10^{-3} risk concentration for construction worker soils, in an effort to maintain consistency with the definition of the HCAA on the former Celotex property as established by prior work performed at that property under oversight from the NJDEP a concentration of 1,000 mg/kg was used define the areas within the 2-to-10-ft-bgs interval to be considered during the FS. Based on these thresholds, seven separate areas of elevated arsenic concentrations, AA-1 through AA-7 (Figure 2-1 of the Technical Impracticability Evaluation), were identified. Although the HCAA is located below 10 ft bgs, this area was also included as a source area to be evaluated.

Each of the 8 arsenic source areas is described in further detail below. In each of these areas, the source material itself, either oxidizing pyritic material or fill material with high concentrations of arsenic, is solid and does not migrate in the subsurface.

HCAA. On the former Celotex property, contains oxidizing pyritic material; however, this material is solid (immobile) and buried under a liner, eliminating the possibility of mobility via wind entrainment; however, it is considered a source to groundwater. The toxicity potential was determined to be low. Oxidizing pyritic waste material contains arsenic above applicable soil standards; however, the depth of the material limits the potential for direct contact with soils exceeding 390 mg/kg in surface soil or 1,000 mg/kg in soil from 2 to 10 ft bgs. The HCAA is not considered a principal threat waste; however, remedial alternatives were developed in the FS to consider technologies that address this area.

Arsenic Area 1. At AA-1, on the Quanta property, the toxicity potential was determined to be moderate. Surface soil in this area does not contain arsenic at concentrations greater than 390 mg/kg, the threshold for 10-3 ELCR for the residential exposure scenario. However, subsurface soil concentrations accessible under the construction worker exposure scenario exceed 1,000 mg/kg.

Arsenic Area 2. At AA-2 on Block 93 Central, toxicity potential was determined to be moderate. Soil concentrations from ^{3} to 5 ft bgs exceed 1,000 mg/kg.

Arsenic Area 3. At AA-3 on the former Lever Brothers property, toxicity potential was determined to be moderate. Surface soil in this area does not contain arsenic at concentrations greater than 390 mg/kg. However, subsurface soil concentrations accessible under the construction worker exposure scenario exceed 1,000 mg/kg. It is anticipated that soil within AA-3 will be addressed as part of separate remedial efforts being conducted on the former Lever Brothers property as part of ISRA Case #E20040267 under oversight from NJDEP.

Arsenic Areas 4. The toxicity potential for AA-4, located on the Block 93 Central property, was determined to be high. The material located between 0 and 2 ft bgs is considered a principal threat waste because arsenic concentrations are greater than the threshold for 10^{-3} ELCR of 390 mg/kg under a residential exposure scenario.

Arsenic Area 5. The toxicity potential for AA-5, located on the Block 93 North property, was determined to be high. The material located between 0 and 2 ft bgs is considered a principal threat waste because arsenic concentrations are greater than the threshold for 10^{-3} ELCR of 390 mg/kg under a residential exposure scenario.

Arsenic Area 6. At AA-6, on the Quanta property adjacent to River Road, the toxicity potential was determined to be high. Shallow soil (0–2 ft bgs) concentrations are greater than the threshold for 10^{-3} ELCR of 390 mg/kg under a residential exposure scenario. Shallow soil at AA-6 is considered a principal threat waste.

Arsenic Area 7. At AA-7, on the Quanta property, the toxicity potential was determined to be high. Shallow soil (0–2 ft bgs) concentrations are greater than the threshold for 10^{-3} ELCR of 390 mg/kg under a residential exposure scenario. Shallow soils at AA-7 are considered principal threat waste.

Nature and Extent of Constituents in Groundwater

The presence of source materials such as NAPL and arsenic source material in soil has resulted in the presence of various constituents in groundwater at OU1. The extent of Site-related constituents in groundwater includes areas on the Quanta property; 115 River Road; the former Lever Brothers property; the former Celotex property; Blocks 93 North, Central, and South; Block 94; and Block 92.01. Additionally, non-Site-related constituents have also been detected in groundwater, including some PAHs, VOCs, and metals present beyond the extent of OU1, in the northeast corner of the former Lever Brothers property, and farther south beyond the zone of groundwater convergence. At the convergence zone, shallow unconfined groundwater from the central portions of the former Lever Brothers property flows to the northeast and converges with groundwater from the Quanta property. This area of convergence coincides with historic drainage features once present in the former marsh deposits that now underlie this portion of the Site and trended from the foot of the Palisades to the Hudson River.

VOCs and SVOCs

A primary constituent of coal tar, naphthalene, was selected as a representative PAH at OU1. Naphthalene in groundwater extends downgradient from known areas of NAPL, and covers an area similar in shape and slightly greater than the portion of the OU1 in which evidence of NAPL has been identified (except where offsite sources of naphthalene are present).

With the exception of naphthalene, the presence of dissolved-phase PAHs exceeding applicable screening criteria was not found in monitoring wells screened in the deep sand unit, indicating that most dissolved-phase PAHs are confined to the shallow fill and native sand deposits above the silty clay aquitard where NAPL and solid tar have been observed (i.e., within OU1).

The extent of non-PAH SVOCs at OU1 are similar to the extent of PAHs. Non-PAH SVOCs at OU1 consist primarily of phenolics (e.g., phenol and 2,4-dimethylphenol), dibenzofuran, and carbazole. Non-PAH SVOCs exceeded the applicable groundwater-screening criteria in a lower percentage of RI and SRI groundwater samples than PAHs and are found primarily in the central portions of the Site. Non-PAH SVOCs do not extend beyond the footprint of the naphthalene plume.

The distribution in groundwater of benzene, a representative aromatic VOC, is also consistent with the known distribution of Site-related NAPL. However, with a greater solubility in groundwater and a lower screening criterion, benzene exceedances in groundwater extend farther hydraulically downgradient of NAPL source material than naphthalene. The footprints of other Site-related VOCs in groundwater at OU1 are located within the lateral extent of benzene exceedances.

Chlorinated VOCs were detected at their highest concentrations in the deep sand groundwater and in shallow groundwater at the foot of the Palisades along the upgradient edge of OU1. The lateral and vertical distribution of these compounds throughout the Site, as well as the relationship of hydraulic heads between the shallow unconfined and deep sand units, indicates that the presence of these chlorinated VOCs is not the result of a release or releases related to Site-specific historical operations.

Inorganics

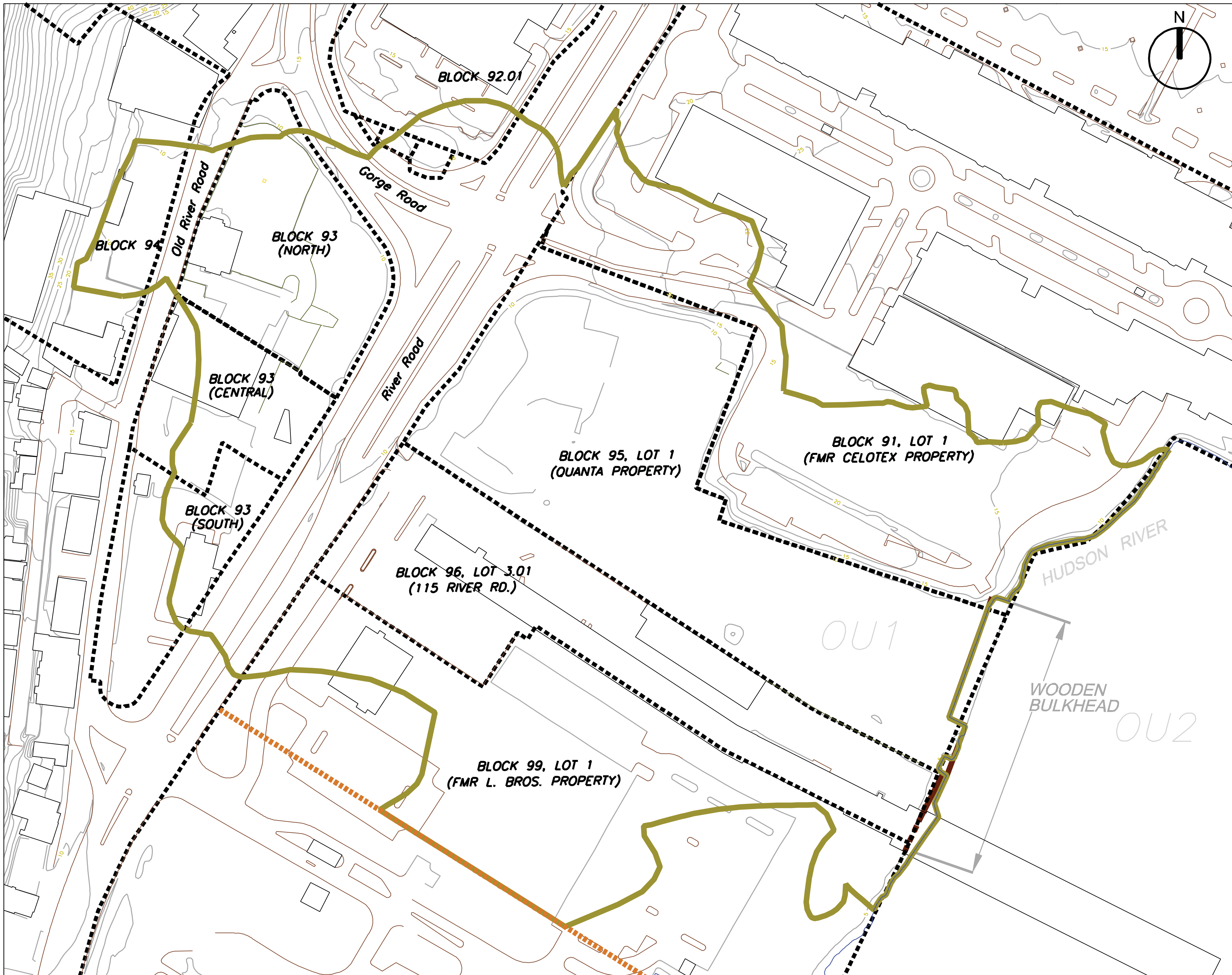
Inorganic constituents are present throughout the Site, with arsenic and iron being the most widespread. Due to the presence of arsenic in soil and groundwater across the Site and at adjacent properties, above the applicable soil standards as a result of the ubiquitous presence of historic fill, the SRI focused on identifying soils that represented sources of arsenic to groundwater. The results of this evaluation are discussed in the subsection "Nature and Extent of Constituents in Soil," above.

Due to differences in the nature and extent of the pyritic sources versus those of the regional fill material, and because lead, unlike arsenic, is not redox sensitive and is expected to be relatively immobile at the Site, the distribution of dissolved lead in groundwater is distinctly different than that of arsenic and iron. Thus, the portions of the Site where lead concentrations are greater than the N.J. Groundwater Quality Standard of 5 µg/L are almost exclusively within the footprint of the former acid plant. This is due to the specific geochemical environment found here as a result of the acid generation caused by the leaching of the pyritic material and the relative strength of the source material in the HCAA compared to other areas.

Ammonia, a byproduct of coal tar distillation, was stored at the Site during historical coal tar operations, but its distribution systems (i.e., piping systems) and potential use in manufacturing are not known. Ammonia concentrations above the lowest screening criterion cover most of the Site, as described in the final RI report (CH2M HILL, 2008a). However, exceedances do not extend downgradient as far as the Hudson River. The distribution of ammonia concentrations observed in groundwater is consistent with the location of previous storage areas as identified in historical maps, suggesting the source of these detected constituents is related to the former coal tar operations.

Pesticides

Groundwater-sampling results indicate that low concentrations of pesticides were detected within the interior portions of the Quanta property. These concentrations represent isolated, noncontiguous groundwater concentrations that are the result of the historical use of pesticides.



LEGEND

- APPROXIMATE CURRENT PROPERTY BOUNDARY
- HUDSON RIVER SHORELINE
- GROUNDWATER CONVERGENCE ZONE
- COMPOSITE EXTENT QUANTA RESOURCES SUPERFUND SITE (OU1) (INCLUDES THE HIGH ARSENIC AREA & QUANTA-RELATED CONSTIUENTS IN GROUNDWATER)

Notes:

1.) A discussion of the extents of the Quanta Resources Superfund Site, Operable Unit 1 (OU1) is provided in Section 8.0 of the Supplemental Remedial Investigtion (SRI) Report (CH2M Hill, 2009).

BASE MAP NOTES:

A. BASE MAP WAS PREPARED BY VARGO ASSOCIATES OF FRANKLINVILLE, NEW JERSEY AND UPDATED AS RECENTLY AS NOVEMBER 2008.

B. PROPERTY LINES SHOWN HEREON IS REFERENCED TO CURRENT TAX MAPS FOR THE BOROUGH OF EDGEWATER, BERGEN COUNTY, NEW JERSEY.

C. REFERENCE PLAN ENTITLED "RIGHT OF WAY MAP, RIVER ROAD RE-ALIGNMENT, SOUTH SECTION, BOROUGH OF EDGEWATER, BERGEN COUNTY, N.J." PREPARED BY BOSWELL ENGINEERING, HACKENSACK, N.J., FILED IN THE BERGEN COUNTY CLERK'S OFFICE AS MAP NO. 9154.

D. HORIZONTAL DATUM IS REFERENCED TO THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD 1983 BASED ON GPS OBSERVATIONS BY VARGO ASSOC. IN SEPTEMBER, 2005.

E. ELEVATIONS SHOWN HEREON ARE IN FEET AND ARE REFERENCED TO N.A.V.D. 1988.

F. TOPOGRAPHIC FEATURES SHOWN HEREON IS REFERENCED TO AERIAL PHOTOGRAPHY PROVIDED BY PROMAPS, MORRESTOWN, N.J. (FLIGHT DATE: 08-17-08).

G. TIDAL DATUMS ARE REFERENCED TO TIDE GUAGE NGS A40 AND NGS 1240 AND ARE AS FOLLOWS:
MEAN HIGHER HIGH WATER ELEVATION=1.90'
MEAN HIGH WATER ELEVATION=1.63'
MEAN TIDE LEVEL ELEVATION=-0.50
MEAN LOW WATER ELEVATION=-2.62'
MEAN LOWER LOW WATER ELEVATION=-2.83'

H. UNDERGROUND UTILITIES SHOWN HEREON ARE NOT NECCESSARILY COMPLETE AND SHALL BE FIELD VERIFIED PRIOR TO ANY CONSTRUCTION.

0 70 140

CH2MHILL

EXTENT OF QUANTA RESOURCES SUPERFUND SITE OPERABLE UNIT 1 (OU1)

Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey

February 24, 2010

FIGURE B-1

400518

FILENAME: CH-Quanta_TIWaiverExtents-2010.02.dgn PLOT DATE: 3/29/2010 PLOT TIME: 3:28:49 PM

Appendix C
Comprehensive Remediation Description

Comprehensive Remediation Approach

1. Introduction

In order to evaluate the restoration potential for groundwater a comprehensive remediation approach was also developed and evaluated, including the removal or treatment of all source material within OU1 using a combination of feasible technologies identified in the Draft Final FS Report (CH2M HILL, 2010b). Cost estimates for this scenario are included in Appendix D.

2. Description of the Comprehensive Remediation Approach

The primary component of the comprehensive remedial approach is to address all sources to groundwater through the use of a combination of in- situ solidification/stabilization and excavation technologies. This scenario includes the demolition of multiple buildings private roadways, parking areas and portions of River Road, Old River Road and Gorge Road in order to access source material. Demolished buildings, roadways and parking areas would be reconstructed following the completion of remedial activities in these areas. The potential for COCs in groundwater to migrate to surface water would be reduced through source control, although offsite sources may still represent a source of COCs to groundwater above ARARs. Components of this scenario are intended to address each major class of target material and are summarized in Table C-1 and detailed in the following subsections.

TABLE C-1
Summary of Comprehensive Remediation Approach
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Target Material	Treatment
NAPL	In situ solidification/stabilization or excavation of tar boils and NAPL zones throughout OU1. Including demolition of building, roadways, and parking areas within OU1.
Arsenic	In situ solidification/stabilization or excavation of arsenic areas throughout OU1. Including under roadways, the access ramp on the former Celotex property, and parking areas.
Residual soil	In situ solidification/stabilization or excavation of residual soils throughout OU1. The ISS areas would be covered with either a single-layer engineered cap (i.e., asphalt) or a vegetative cap.
Groundwater	All identified sources to groundwater within OU1 would be treated. Groundwater monitoring would be performed following remedial activities to monitor the reduction in the concentrations in site related COCs.

Demolition

In order to gain access to all sources to groundwater, this approach would include the demolition of buildings at 115 River Road, Block 93, the access ramp and parking areas on the former Celotex property and portions of River Road and the intersection of River Road–Gorge Road.

Non–Aqueous Phase Liquid and Arsenic Source Areas

NAPL source areas (NZ-1 through NZ-6), tar boils, arsenic source areas (HCAA and AA-1 through AA-10) and all residual soils impacted with NAPL and other site-related constituents throughout OU1 would be either solidified/stabilized in situ, or excavated.

In Situ Solidification/Stabilization

Following demolition activities and prior to implementation of in situ mixing, each property would be cleared of vegetation and surface and subsurface debris (including large boulders, tank pads, conduits, and concrete), and these materials would be disposed of offsite. It is assumed that the depth of debris removal would generally be to 4 ft, with some deeper debris removed as necessary. The clean fill material present on the former Celotex property does not need to be stabilized and may be temporarily removed and stockpiled prior to remediation and then replaced after completion. For cost-estimating purposes, cleared material to be disposed of offsite is assumed to be hazardous.

A temporary barrier may be installed along the shoreline to mitigate NAPL migration during implementation and to act as a turbidity barrier. The portions of the temporary barrier that are adjacent to shoreline with no existing bulkhead could remain to reduce the erosion effects of the tides or be replaced with protective rip-rap. For costing purposes, it is assumed that the temporary barrier will remain in place and be removed prior to redevelopment.

Solidification/stabilization would be implemented from the shoreline moving inland, so that equipment remains on unsolidified material. Stabilization/solidification behind the bulkhead would be performed in sequenced or alternating patterns to protect bulkhead tie backs and prevent shoreline instability during cement setup.

Target depths would be established based on source zone characterization. Reagents would be injected or introduced using the most appropriate methods in order to comprehensively treat the targeted source material between the ground surface and the target depth. Exact application methods will depend on the depth of treatments, consistency and hardness of soil, and soil porosity. Vapor and noise management controls would be put in place to protect workers and the community during construction activities.

As part of the predesign tasks and prior to implementation of the soil mixing, bench-scale testing would be performed. For cost-estimating purposes, it was assumed that 15 percent cement by weight would be used to solidify/stabilize soils in place and the treated soils would expand by 25 percent. During implementation of the full-scale remedial action, testing would be performed for the purposes of mix optimization, quality assurance, and verification that the remedy is effective. Verification sampling details would be developed during remedial design and may include tests of strength, permeability, and leachability.

Excavation

Prior to excavation, each property would be cleared of vegetation. Excavations would extend below 4 ft and will require dewatering. Water extracted for dewatering would be treated onsite and discharged to the Hudson River. Excavation depths of 20 ft can be achieved with readily available excavation equipment. Deeper excavation and excavation below the water table is possible with more-specialized equipment. Excavation of high concentration arsenic soils adjacent to the hotel on the former Celotex property may require the use of shoring (e.g., sheet piles) to protect utility lines, building foundations, etc. For costing purposes, it was estimated that the access to this business will be eliminated for approximately 8 months.

A verification sampling plan describing the approach to be used to determine the extent of excavations will be developed. Specific stormwater diversion, soil erosion controls, and air-monitoring would also be implemented during construction, as would controls for mitigating the potential risk of NAPL mobilization to the river. The excavation areas would be backfilled and compacted with certified clean fill material.

Large-scale excavations requiring dewatering may result in unforeseen impacts to the Site. Such impacts may include additional release of site-related constituents including NAPL into OU2 and potential mobilization of previously stable NAPL. Engineering controls would need to be robust enough to mitigate the potential risk of erosion or NAPL mobilization.

Air monitoring would be important during excavation and to evaluate the appropriate PPE for workers. In addition, emission control techniques such as using dust and odor suppressants and minimizing the open working area of the excavation would be employed as needed to minimize adverse effects on workers and the community from volatile emissions of NAPL. Robust mitigation measures to reduce adverse impacts to the community from increased truck traffic would need to be evaluated for implementation during construction.

Based on a comparison of the NAPL chemical characteristics and soil concentrations, it is anticipated that the excavated soils would be classified as hazardous waste. Onsite stabilization of soils would be necessary prior to their disposal to meet land disposal restrictions. Soil would be stockpiled, stabilized, and then disposed of at an offsite landfill. Details of sampling requirements for excavated soils, required treatment, and disposal options would be finalized during remedial design.

Several hazardous waste landfills in North America receive, stabilize, and dispose of characteristically hazardous soil. These facilities would likely accept the tar- and arsenic-contaminated soil from the site for treatment prior to disposal. Media would be either stabilized onsite then transported and disposed of as nonhazardous waste or directly transported to a hazardous waste landfill for disposal and stabilization on location. It is assumed for this evaluation that material will be stabilized onsite and disposed of as nonhazardous. Prequalification samples would be analyzed to determine whether the waste is acceptable for onsite processing and disposal and whether the material can be processed and disposed of in the landfill.

Prior to any excavation, a barrier cutoff wall would be installed along the shoreline to prevent NAPL migration during implementation and to provide the necessary structure support to the bulkhead during the removal of soils behind the bulkhead.

Capping and Restoration

Solidification/stabilization areas would be graded and capped with an engineered cap to prevent direct contact and minimize erosion by controlling surface water runoff. The cap for the properties within OU1 would be either a single-layer engineered cap or multilayer vegetative cap. Cap design would be consistent with NJDEP (1998) guidance for the remediation of contaminated soils. The buildings on the 115 River Road and Block 93 properties would be reconstructed.

Fill may be imported to bring the vegetative cap on the Quanta property up to the same elevation as the adjacent properties (i.e., former Celotex and 115 River Road properties) for redevelopment purposes; however, this action is not considered a component of the scenario.

Groundwater

The source of COCs to the groundwater would be either treated or removed in this scenario; therefore, as part of this approach, groundwater monitoring would be completed to monitor reductions in the COC concentrations in Site-related groundwater.

For cost estimating purposes, it is assumed that 40 monitoring wells will be sampled quarterly for the first year and annually thereafter for VOCs, SVOCs, arsenic, and geochemical parameters necessary for evaluating natural attenuation. After the remedy has been implemented and groundwater concentrations are stable, the monitoring network and sampling frequency would be reevaluated.

Institutional Controls

The institutional controls (ICs) for this approach include land-use restrictions, construction restrictions, and engineering controls, similar to those described in previous sections for the Expanded FS Alternatives.

3. Evaluation of the Comprehensive Remediation Alternative

The comprehensive remediation approach discussed above was briefly evaluated against the NCP evaluation criteria and in the context of the FS alternatives, as discussed in the following subsections.

Overall Protection of Human Health and the Environment

Although the comprehensive remediation approach, once complete, would achieve a condition of protectiveness, extensive engineering controls would be required during implementation to protect human health and the environment for the duration of remedial activities.

Each alternative presented in the Draft Final FS Report (CH2M HILL, 2010b) is designed to minimize human health risk, either by treatment or removal of COCs, or by elimination of complete exposure pathways through engineering and ICs. The comprehensive remediation approach also reduces human health risk; however, the overall risk reduction is no greater than that achieved by the FS alternatives. Similar engineering controls are required at exposure points to eliminate pathways to potential receptors (i.e., the SRB installed in OU2 and groundwater use restrictions throughout OU1). Though the technologies are expanded, the level of protectiveness to human health and the environment is no different, and the short-term risks during implementation increase as the volume of targeted source material increases.

The comprehensive remediation approach is designed to protect human health and the environment through a combination of in situ solidification/stabilization and excavation and offsite disposal. Although once construction activities are complete, no site-related source material will remain onsite, the short-term risks to the community during remedy implementation are far greater than with the remaining alternatives, due to the much larger volume of soil to be removed or treated.

Compliance with ARARs

Although the goal of the comprehensive remediation approach is to treat or remove all Site-related source areas, restoration of groundwater to conditions meeting chemical-specific ARARs through OU1 is impracticable due to Site-specific conditions, as discussed in Section 3 of the Technical Impracticability Evaluation. Under ideal conditions, the comprehensive remediation approach may achieve ARARs temporarily; however, offsite conditions and regional characteristics would still prevent achievement of chemical-specific ARARs in groundwater. Due to Site-specific contaminant and hydrologic factors as well as other Site-related factors, ideal conditions are not present and complete remediation of all source material is not technically feasible.

Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence of alternatives vary largely as a result of the adequacy and reliability of the systems implemented. The comprehensive remediation approach appears to offer a comparatively higher degree of long-term effectiveness at this site than the alternatives evaluated in the FS because the largest quantity of waste material would be physically removed or treated; however, as with all of the alternatives, either onsite residuals remaining after construction or offsite sources would re-contaminate groundwater.

In addition, for this approach, the material would be disposed of at an offsite landfill where it would continue to be a potential source and leaching concern even at an offsite landfill.

The in situ solidification/stabilization used in Expanded Alternative 4 and the original FS Alternative 4 is considered effective over the long term, and assurance would be ascertained through bench and pilot testing prior to remedy implementation, performance testing during implementation, and long-term monitoring after implementation. This technology would not remove the contaminants but would immobilize them permanently onsite. This technology would permanently sequester COCs in target areas and significantly reduce the potential for this material to act as an ongoing source of COCs to groundwater and air.

Expanded Alternative 5 and the original FS Alternative 5 also incorporate shallow excavation, increasing the long-term effectiveness and permanence of these alternatives. While in situ chemical oxidation would be irreversible if implemented and thus would have a high degree of long-term effectiveness, there is significant uncertainty as to whether this technology would be successful at the site. Also, during implementation currently immobile

NAPL may be mobilized through the heat of reaction, and would require engineering controls to mitigate potential impacts from its migration.

Any of the FS alternatives, if implemented, would result in a condition where residual NAPL and arsenic source material remains on site and continue to contribute constituents to groundwater.

Under ideal conditions, the comprehensive remediation approach may achieve groundwater standards temporarily; however site-specific contaminant and hydrologic factors as well as other site-related factors would preclude the ultimate success of this approach and offsite sources and regional characteristics would recontaminate OU1 over time, and groundwater would remain unsuitable for potable use. Therefore, additional controls in the form of groundwater use restrictions and engineering controls to eliminate exposure pathways to media containing COCs would be required to effectively protect human health. These same controls are required for each of the alternatives presented in the Draft Final FS Report; therefore no incremental benefit would be achieved through implementation of the comprehensive remediation approach.

Reduction of Toxicity, Mobility, and Volume through Treatment

The comprehensive remedial approach offers a greater reduction in toxicity, mobility, and volume (TMV) than the remedial alternatives presented in the Draft Final FS Report; however, as part of this approach, a portion of the waste material at the Site would be transferred to another location. Furthermore, there is a potential for increasing the mobility of NAPL and dissolved phase constituents during implementation.

Short-Term Effectiveness

Although there are potential short-term impacts to the worker, community, and environment during the implementation of each of the Draft Final FS alternatives, the comprehensive remediation approach poses the highest potential risks for workers, the community, and the environment due to the potential for mobilizing NAPL and the increased potential for NAPL volatilization. The comprehensive remediation approach would require additional controls beyond those presented as part of the Draft Final FS alternatives to mitigate potential risks to the surrounding community from increased odor and vehicular traffic. This approach would require more time to implement and more controls to protect the community during construction.

Following implementation of the comprehensive approach, RAOs for the Site would be achieved. The RAOs to prevent unacceptable risk as a result of direct exposure to soils and prevent erosion would be met immediately following cap construction and establishment of ICs for each alternative. The RAO to prevent migration of COCs to OU2 would be met immediately after the installation of the SRB and establishment of ICs for each alternative. Although RAOs would be achieved (and thus risks to human health and the environment would be mitigated) through implementation of either the Draft Final FS alternatives or the comprehensive remediation approach, ARARs are not expected to be achieved due to the Site-specific factors discussed in Section 3 of the Technical Impracticability Evaluation that make the identification, access, and treatment/removal of all Site-related sources to groundwater technical impracticable. Furthermore, offsite sources and poor regional groundwater quality conditions would be expected to continue to contaminate OU1 and prevent ARARs from being achieved.

Implementability

Implementability considerations for the FS alternatives are discussed in detail in the Draft Final FS Report. Implementability challenges associated with the comprehensive remediation scenario are greatly magnified and include:

Building Demolition

The implementation of the comprehensive remediation approach would involve the complete or partial demolition of currently active buildings at 115 River Road, Block 93 North, Central and South. Removing these buildings is likely to result in litigation, which could significantly delay the remedy's implementation. Further delays as a result of demolition of additional buildings to facilitate implementation of the comprehensive remediation scenario are expected to similarly delay this approach. Significant factors in the implementation of this approach as they relate to the demolition of the buildings located with the boundaries of OU1 include:

- All buildings are privately owned buildings on privately owned property.
- Removal of any building is extremely likely to result in litigation, which could significantly delay the remedy's implementation.
- Significant costs and delays in the implementation of the remedy would result from the demolition, reconstruction, business relocation, and (or) disruption, and litigation.
- There would be additional cost and losses associated with:
  - Differential in rent to displaced tenants
  - Specialty improvements at new location (sinks, x-ray shielding, etc.)
  - Lost business costs to tenants
  - Loss of customers or clients or employees during move and if relocated too far away
  - Losses due to move may put some businesses out of business
  - Loss of business to local restaurants and stores from relocated tenants and their clients

Road Closures

As presented in the Draft Final FS report (CH2M HILL, 2010b), the 600- to 700-foot section of River Road at and immediately south of Gorge Road should not be closed to traffic for an extended period of time. The review and observations conclude:

- The magnitude of existing traffic volumes require the number of lanes that are currently on River Road to operate safely and efficiently.
- There is no other "through" roadway or connecting local road system serving Edgewater to which to divert and accommodate these traffic volumes.

- Direct access to several highly active residential and commercial properties adjacent to and proximate to this section of River Road would be adversely affected.
- The roadway closure would negatively impact the town's community and emergency services.
- Access to the Palisades Medical Center in responding to life-threatening situations would be negatively impacted.
- There is no existing roadway network in the vicinity of River Road to serve as a detour around the potential closure.
- There is no available River Road right-of-way on which to construct a detour in the vicinity of the potential River Road closure.
- Through and local truck traffic would be impeded and, therefore, may negatively impact other municipal roads.
- A potential River Road closure at this location may negatively impact the entire length of River Road from a traffic congestion perspective due to the separation of the Cliffs from other parallel roads and the limited road system that traverses the Cliffs.
- A potential River Road closure at this location may negatively impact roadway systems in other communities above the Cliffs such as along Boulevard East and Palisades Avenue.

Subsurface Obstructions

Large boulders and riprap exist on the former Celotex property at NZ-5:

- Installation of NAPL recovery wells (Expanded Alternative 5) would require drilling technology able to penetrate bouldery fill.
- Installation of a cutoff wall (Expanded Alternatives 5 and 6) would require removing overlying bouldery fill prior to barrier placement.
- In situ solidification/stabilization (Expanded Alternative 4) would also require excavation of subsurface boulders prior to mixing.
- In situ chemical oxidization (Expanded Alternative 5) may require either excavating boulders or using drilling technologies able to penetrate the fill material.

Active Utilities

Alternatives involving in situ technologies or excavation will require working around utilities. Temporary outages during implementation may be required.

Environmental Testing, Monitoring, and Controls

Bench- and pilot-scale testing would be required:

- Stormwater controls and fence line monitoring for dust and emissions
- Temporary controls to prevent mobilization of free-phase NAPL to OU2

- Water flow patterns would need to be modeled for adequate control in alternatives involving placement of barriers to groundwater flow or in situ solidification/stabilization (Expanded Alternatives 4 and 5)
- Air monitoring and engineering controls
  - Most complicated for the comprehensive remediation alternative and Expanded Alternatives 5 and 6, which could result in the generation of large amounts of vapor
  - Expanded Alternatives 4 and 5 pose additional implementability considerations involving soil expansion impacts, and effective distribution of reagent to target treatment areas

Cost

The cost evaluation and resulting conclusions have been prepared for guidance in project evaluation and implementation from the information available at the time that the cost evaluation was prepared. A detailed cost estimate for the comprehensive remediation approach is presented in Appendix D. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, and other variable factors. As a result, the final project costs will vary from the cost estimates presented in Table D-1.

Appendix D
Comprehensive Remediation Cost Estimate

TABLE D-1
Summary of Comprehensive Remedial Alternatives
Draft TI Evaluation, Quanta Resources Site, Edgewater, New Jersey

	Comprehensive Remedial Alternative	
	Primarily In Situ Solidification/ Stabilization	Primarily Excavation
Total Capital Cost	**$385,450,000**	**$848,870,000**
Soil	$382,900,000	$838,380,000
Groundwater	$2,550,000	$10,490,000
NAPL	$0	$0
Total O&M Cost	**$1,231,000**	**$1,718,400**
Total Periodic Cost	**$15,000**	**$15,000**
Total Present Value	**$386,500,000**	**$851,800,000**

Disclaimer: The information in this cost estimate is based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternatives. This is an order-of-magnitude cost estimate that is expected to be within +50 to -30 percent of the actual project costs. Rev. March 30, 2010.

Comprehensive Remediation Alternative 4: In Situ Solidification/Stabilization — COST ESTIMATE SUMMARY - DRAFT

Site: Quanta Resources Site-Edgewater, New Jersey
Media Groundwater, Soil and NAPL
Phase: Draft TI Waiver
Base Year: 2010
Date: 2/11/2010

Description:

NAPL	In situ solidification/stabilization of tar boils and NAPL zones throughout OU1. Including demolition of building, roadways, and parking areas within OU1.
Arsenic	In situ solidification/stabilization of arsenic areas throughout OU1. Including under roadways, the access ramp on the former Celotex property, and parking areas.
Residual Soil	In situ solidification/stabilization of residual soils throughout OU1. The ISS areas would be covered with either a single-layer engineered cap (i.e., asphalt or a vegetative cap). ICs would be established t place restrictions on future land use and control future construction and redevelopment activities.
Groundwater	All sources to groundwater would be treated, therefore, only groundwater monitoring would be performed following remedial activities.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	Costing Basis	Assumptions
SOIL						
General Site Work						
Mobilization/Demobilization	7%		$ 194,984,133	$ 13,648,889		Calculate as 7% of capital cost; higher due to ISS
Subcontractor General Conditions	20%		$ 194,984,133	$ 38,996,827		Calculate as 10% of capital cost
SUBTOTAL				*$ 52,645,716*		
Site Establishment						
Survey	100	DY	$ 1,500	$ 150,000	CCI Historical	
Utility Survey, Geophysical Survey	1	LS	$ 190,000	$ 190,000	CH2M Est.	
Fencing	6,000	LF	$ 15	$ 90,000	CCI Historical	
Trailer Installation & Setup	2	EA	$ 3,000	$ 6,000	CH2M Est.	Tie-downs, stairs, power
Support Area Establishment and Site Offices	36	MO	$ 4,300	$ 154,800	CH2M Est.	Includes shed, utilities, lavatories
SUBTOTAL				*$ 590,800*		
Institutional Controls (Quanta, 115 River Road, Edgewater, Block 93 North, Block 93 Central, Block 93 South, River Road ROW, Gorge Road ROW, Former Lever Bros)						
Deed Notices (1 for each property)	9	LS	$ 25,000	$ 225,000	CH2M Est.	Draft deed covenant, coordination with regulators, public involvement, professional services, and filing deed covenant
Security Service	36	MO	$ 12,000	$ 432,000	CH2M Est.	
SUBTOTAL				*$ 657,000*		
Clearing & Vegetation/Debris Disposal						
Site Clearing & Disposal (Quanta Property)						
Temporary erosion controls (silt fencing)	3,000	LF	$ 1.28	$ 3,852	MEANS 31.25.13.10.1100	Surrounding property boundary
Clear and Grub Heavy Brush & Trees (includes chipper)	5.5	AC	$ 8,203	$ 44,851	MEANS 31.11.10.10.0260	Clear & grub brush, including stumps, from the Quanta site
Tank pad, concrete & debris removal @ NZ-1 and NZ-2	31,422	TON	$ 128	$ 4,011,001	MEANS 02.41.13.17.5500	Demolition of debris in top 4-ft in NZ-2 and 2-ft throughout NZ-1 (assumes 1.65 ton/cy)
Asphalt removal	3,969	SY	$ 3.76	$ 14,925	MEANS 02.41.13.17	Assumes 3" thick asphalt to be cleared from 15% of Quanta
Subsurface piping abandonment	1	LS	$ 250,000	$ 250,000		Engineer's Estimate
Offsite disposal of cleared materials, concrete (including transportation to < 50 miles)	19,639	CY	$ 130	$ 2,553,027		
Asphalt Disposal	437	CY	$ 25	$ 10,925	Source 3	
Dust suppression	60	DY	$ 820	$ 49,201	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
SUBTOTAL				*$ 6,937,781*		
Site Clearing & Disposal (Block 93, 115 River Road)						
Temporary erosion controls (silt fencing)	2,100	LF	$ 1.28	$ 2,696	MEANS 31.25.13.10.1100	Surrounding property boundary
Asphalt removal	26,520	SY	$ 3.76	$ 99,716	MEANS 02.41.13.17	Assumes 3" thick asphalt to be cleared from Block 93 and 115 River Road
Asphalt Disposal	2,917	CY	$ 25	$ 72,925	Source 3	
Dust suppression	5	DY	$ 820	$ 4,100	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
SUBTOTAL				*$ 179,438*		
Site Clearing & Disposal (Edgewater - Arsenic Area)						
Temporary erosion controls (silt fencing)	1,500	LF	$ 1.28	$ 1,926	MEANS 31.25.13.10.1100	Surrounding property boundary
Concrete removal & sizing to less than 2'	6,061	TON	$ 118	$ 715,159	MEANS 02.41.13.17.5500	Concrete demolition of access ramp, assumes 2-ft of concrete
Asphalt removal	6,361	SY	$ 3.76	$ 23,918	MEANS 02.41.13.17	Assumes 3" thick asphalt to be cleared from area above the arsenic liner
Offsite disposal of concrete (including transportation to < 50 miles)	3,367	CY	$ 130	$ 437,715	MEANS 33-19-7270	Assumes non-HW landfill
Asphalt Disposal	700	CY	$ 25	$ 17,500	Source 3	
Dust suppression	40	DY	$ 820	$ 32,801	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Dig Permits & Utility Markout	10	DY	$ 3,000	$ 30,000	Source 3	
Excavation, stockpile and backfill of 10-ft of soils above the existing arsenic liner	21,204	CY	$ 35	$ 750,473	MEANS 17-03-0276	Assumes material will be replaced following the completion of arsenic stabilization
Temporary Access	1	allow	$ 65,000	$ 65,000		
SUBTOTAL				*$ 2,074,491*		
Site Clearing & Disposal (Edgewater)						
Temporary erosion controls (silt fencing)	2,000	LF	$ 1.28	$ 2,568	MEANS 31.25.13.10.1100	Surrounding property boundary
Concrete removal & sizing to less than 2'	6,438	TON	$ 118	$ 759,684	MEANS 02.41.13.17.5500	
Asphalt removal	14,250	SY	$ 3.76	$ 53,580	MEANS 02.41.13.17	Assumes 3" thick asphalt to be cleared from area above the arsenic liner
Offsite disposal of concrete (including transportation to < 50 miles)	3,577	CY	$ 130	$ 464,967	MEANS 33-19-7270	Assumes non-HW landfill
Asphalt Disposal	1568	CY	$ 25	$ 39,200	Source 3	
Dust suppression	30	DY	$ 820	$ 24,600	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Dig Permits & Utility Markout	5	DY	$ 3,000	$ 15,000	Source 3	
Excavation and stockpile of 10-ft of backfill	4,750	CY	$ 30	$ 141,075	MEANS 17-03-0276	Assumes material can be replaced
Temporary Access	1	allow	$ 65,000	$ 65,000		
SUBTOTAL				*$ 1,565,674*		
Site Clearing & Disposal (Lever Brothers)						
Temporary erosion controls (silt fencing)	750	LF	$ 1.28	$ 963	MEANS 31.25.13.10.1100	Surrounding property boundary
Asphalt removal	1,505	SY	$ 3.76	$ 5,660	MEANS 02.41.13.17	Assumes 3" thick asphalt to be cleared
Asphalt Disposal	166	CY	$ 25	$ 4,150	Source 3	
Dust suppression	7	DY	$ 820	$ 5,740	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Dig Permits & Utility Markout	1	DY	$ 3,000	$ 3,000	Source 3	
SUBTOTAL				*$ 19,514*		
Demolition of 115 River Road						
Temporary relocation of tenants	1	LS	$ 2,000,000	$ 2,000,000	Assumes 60 businesses moved twice - cost provided by Honeywell real estate group	
Loss of rent	1	LS	$ 7,000,000	$ 7,000,000	Assumes 3 yrs - cost provided by Honeywell real estate group	
Differential in rent for tenants	1	LS	$ 500,000	$ 500,000	Cost provided by Honeywell real estate group	
Building demolition	1	LS	$ 2,000,000	$ 2,000,000	Assumes bldg 86,000 ft^2 - cost provided by Honeywell real estate group	
Building reconstruction	1	LS	$ 39,000,000	$ 39,000,000	Cost provided by Honeywell real estate group	
SUBTOTAL				*$ 50,500,000*		
Temporary Shutdown of Hotel on Former Celotex						
Loss of business	1	LS	$ 5,365,500	$ 5,365,500	Assumes 58% occupancy at $14700/night for 1 year	
SUBTOTAL				*$ 5,365,500*		
Demolition of Jonas Restaurant						
Temporary relocation of business	1	LS	$ 300,000	$ 300,000	Assumes businesses moved twice - cost scaled from 115 River Road	
Loss of rent	1	LS	$ 900,000	$ 900,000	Assumes 3 yrs - cost scaled from 115 River Road	
Differential in rent for tenants	1	LS	$ 100,000	$ 100,000	Cost provided by Honeywell real estate group	
Building demolition	1	LS	$ 300,000	$ 300,000	Assumes bldg 10,000 ft^2 - **cost scaled from 115 River Road**	
Building reconstruction	1	LS	$ 4,600,000	$ 4,600,000	Cost scaled from 115 River Road	
SUBTOTAL				*$ 6,200,000*		
Demolition of Medical Arts Building						
Temporary relocation of tenants	1	LS	$ 500,000	$ 500,000	Assumes businesses moved twice - cost scaled from 115 River Road	
Loss of rent	1	LS	$ 1,500,000	$ 1,500,000	Assumes 3 yrs - cost scaled from 115 River Road	
Differential in rent for tenants	1	LS	$ 200,000	$ 200,000	Cost provided by Honeywell real estate group	
Building demolition	1	LS	$ 500,000	$ 500,000	Assumes bldg 18,000 ft^2 - cost scaled from 115 River Road	
Building reconstruction	1	LS	$ 8,200,000	$ 8,200,000	Cost scaled from 115 River Road	
SUBTOTAL				*$ 10,900,000*		
Demolition of Block 93 Central Buildings						
Building demolition	1	LS	$ 1,200,000	$ 1,200,000	Assumes bldg 49,000 ft^2 - cost scaled from 115 River Road	
Building reconstruction	1	LS	$ 22,300,000	$ 22,300,000	Cost scaled from 115 River Road	
SUBTOTAL				*$ 23,500,000*		
Demolition of River Road and Intersection of River Road and Gorge Road						
Temporary erosion controls (silt fencing)	1,400	LF	$ 1.28	$ 1,798	MEANS 31.25.13.10.1100	Surrounding property boundary
Traffic Detour	8	MO	$ 35,400	$ 283,200	2 FTE plus arrow boards and barricades	
Utility Shutdowns	1	LS	$ 80,000	$ 80,000	Assumes bypass not required.	
Remove Storm drains	4,000	LF	$ 20	$ 80,000		
Remove Sanitary Sewer	1,600	LF	$ 20	$ 32,000		
Remove Traffic Control	1	LS	$ 8,000	$ 8,000		
Remove Electrical	3,000	LF	$ 18	$ 54,000		
Remove Waterlines	4,000	LF	$ 15	$ 60,000		
Remove Communications	2,000	LF	$ 10	$ 20,000		
Remove Street Lighting	1,400	LF	$ 30	$ 42,000		
Disposal of Soil	14,300	CY	$ 130	$ 1,859,000	Assume 5 foot depth	
Concrete removal	10,284	SY	$ 3.76	$ 38,667	MEANS 02.41.13.17	
Concrete disposal	762	CY	$ 25	$ 19,044	Source 3	Assumes 2-ft thick concrete to be cleared
Dust suppression	10	DY	$ 820	$ 8,200	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Dig Permits & Utility Markout	2	DY	$ 3,000	$ 6,000	Source 3	
SUBTOTAL				*$ 2,591,909*		
Treatment						
In Situ Solidification/Stabilization - OU1						
Cement	960,000	CY	$ 30	$ 28,800,000		
Arsenic Reagent	240,000	CY	$ 22	$ 5,280,000		Assumes additional reagents will be needed in 25% of OU1
NAPL Area - Stabilization	960,000	CY	$ 35	$ 33,600,000		
SUBTOTAL				*$ 67,680,000*		

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Comprehensive Remediation Alternative 4: In Situ Solidification/Stabilization — COST ESTIMATE SUMMARY - DRAFT

Restoration

Restoration of Block 93 North, Block 93 Central, Block 93 South						Assume no clean fill needed, no clearing unless included above, asphalt removal & disposal included above
Fine grading	16,666	SY	$ 1.42	$ 23,693	MEANS 17-03-0101	Assume no fill needed for grading
Gravel Base, 6 inches	2,780	CY	$ 53.47	$ 148,658	MEANS 32.11.23.23.1511	
Storm water control (3' x 3' culverts, rip-rap)	8	EA	$ 11,638	$ 93,101	Source 4	Included 2 storm water control systems per capped property
Asphalt stabilized binder course, 2" thick	16,666	SY	$ 22.89	$ 381,461	MEANS 32.12.16.13.0120	
Asphalt wear course, 2" thick	16,666	SY	$ 23.43	$ 390,502	MEANS 32.12.16.13.0380	
Install Asphalt Curb/Berm on Perimeter	1,000	LF	$ 11.04	$ 11,040	MEANS 32.16.19.10.0150	
SUBTOTAL				*$ 1,048,456*		
Restoration of 115 River Road Property						
Asphalt removal	7,059	SY	$ 3.76	$ 26,543	Source 3	3" thick asphalt
Fine grading	7,059	SY	$ 1.42	$ 10,036	MEANS 17-03-0101	Assume no fill needed for grading
Gravel Base, 6 inches	1,180	CY	$ 53.47	$ 63,100	MEANS 32.11.23.23.1511	
Storm water control (3' x 3' culverts, rip-rap)	2	EA	$ 11,638	$ 23,275	Source 4	Included 2 storm water control systems per capped property
Asphalt stabilized binder course, 2" thick	7,059	SY	$ 22.89	$ 161,583	MEANS 32.12.16.13.0120	
Asphalt wear course, 2" thick	7,059	SY	$ 23.43	$ 165,412	MEANS 32.12.16.13.0380	
Install Asphalt Curb/Berm on Perimeter	2,100	LF	$ 11.04	$ 23,184	MEANS 32.16.19.10.0150	
Asphalt disposal (recycled)	590	CY	$ 25	$ 14,750	Source 3	3" thick asphalt
SUBTOTAL				*$ 487,884*		
Restoration of Block 94 and 92.01						
Asphalt removal	3,668	SY	$ 3.76	$ 13,792	MEANS 02.41.13.17	3" thick asphalt
Fine grading	3,668	SY	$ 1.42	$ 5,215	MEANS 17-03-0101	Assume no fill needed for grading
Gravel Base, 6 inches	68	CY	$ 53.47	$ 3,632	MEANS 32.11.23.23.1511	
Storm water control (3' x 3' culverts, rip-rap)	4	EA	$ 11,638	$ 46,551	Source 4	Included 2 storm water control systems per capped property
Asphalt stabilized binder course, 2" thick	3,668	SY	$ 22.89	$ 83,957	MEANS 32.12.16.13.0120	
Asphalt wear course, 2" thick	3,668	SY	$ 23.43	$ 85,947	MEANS 32.12.16.13.0380	
Install Asphalt Curb/Berm on Perimeter	1,239	LF	$ 11.04	$ 13,675	MEANS 32.16.19.10.0150	
Asphalt disposal (recycled)	1,239	CY	$ 25	$ 30,967	Source 3	3" thick asphalt
SUBTOTAL				*$ 283,734*		
Cover for Quanta and Lever Bros. Property						
Rough grading	27,970	SY	$ 5.15	$ 144,048	MEANS 17-03-0101	
Fine grading	27,970	SY	$ 1.42	$ 39,765	MEANS 17-03-0101	
Fill to match grade in adjacent properties	500	CY	$ 18	$ 8,851	MEANS 17-03-0423	
Protective layer, 6" compacted soil subgrade	4,660	CY	$ 18	$ 82,494	MEANS 17-03-0423	
HDPE Liner, 40 mil thick	27,970	SY	$ 15	$ 431,584	ECHOS 33.08.0572	
Drainage layer, 6" granular soil (assume gravel)	4,660	CY	$ 53	$ 249,190	MEANS 32.11.23.23.1511	
Grade, Place Geotextile filter fabric	27,970	SY	$ 2.00	$ 55,941	Source 3	
Hydroseed	251,700	SF	$ 0.07	$ 17,619	Source 3	
SUBTOTAL				*$ 1,029,491*		
Restoration of Celotex						
Rough grading	14,250	SY	$ 5.15	$ 73,388	MEANS 17-03-0101	
Fine grading	14,250	SY	$ 1.42	$ 20,259	MEANS 17-03-0101	
Gravel Base, 6 inches	2,380	CY	$ 53.47	$ 127,269	MEANS 32.11.23.23.1511	
Storm water control (3' x 3' culverts, rip-rap)	5	EA	$ 11,638	$ 58,188	Source 4	Included 2 storm water control systems per capped property
Asphalt stabilized binder course, 2" thick	14,250	SY	$ 22.89	$ 326,168	MEANS 32.12.16.13.0120	
Asphalt wear course, 2" thick	14,250	SY	$ 23.43	$ 333,899	MEANS 32.12.16.13.0380	
Install Asphalt Curb/Berm on Perimeter	2,100	LF	$ 11.04	$ 23,184	MEANS 32.16.19.10.0150	
SUBTOTAL				*$ 962,355*		
Replacement of Access Ramp and Parking Lots (Edgewater)						Assume no clean fill needed, no clearing unless included above, asphalt removal & disposal included above
Surveying	10	DY	$ 1,500	$ 15,000		
Backfilling and compaction of excavated material	21,204	CY	$ 18	$ 375,358	MEANS 17-03-0423	Assumes 1.2x excavated material required for compaction
Rough site grading	8,275	SY	$ 5.15	$ 42,580	MEANS 17-03-0101	Assume no fill needed for grading
Fine grading	8,275	SY	$ 1.42	$ 11,764	MEANS 17-03-0101	Assume no fill needed for grading
Surface course (2-inch)	8,275	SY	$ 22.89	$ 189,407	MEANS 32.12.16.13.0120	
Stabilized base course (2.5-inch)	8,275	SY	$ 23.43	$ 193,896	MEANS 32.12.16.13.0380	
Dense graded aggregate base course (4-inch)	8,275	SY	$ 30.09	$ 248,995	MEANS 32.12.16.13	
Replace Access Ramp	3,030	CY	$ 1,200	$ 3,636,000	CH2M Hill Estimate	
Dust suppression	60	DY	$ 820	$ 49,201	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Storm water inlets	2	EA	$ 11,638	$ 23,275	Source 4	
Concrete Curb on Perimeter	2,500	LF	$ 11	$ 27,600	MEANS 32.16.19.10.0150	
SUBTOTAL				*$ 4,813,075*		
Replacement of River Road and Intersection of River and Gorge Roads						Assume no clean fill needed, no clearing unless included above, asphalt removal & disposal included above
Surveying	12	DY	$ 1,500	$ 18,000		
Rough site grading	15,349	SY	$ 5.15	$ 78,978	MEANS 17-03-0101	Assume no fill needed for grading
Fine grading	15,349	SY	$ 1.42	$ 21,821	MEANS 17-03-0101	Assume no fill needed for grading
Surface course (2-inch)	15,349	SY	$ 22.89	$ 351,316	MEANS 32.12.16.13.0120	Asphalt pricing includes haul
Stabilized base course (2.5-inch)	15,349	SY	$ 23.43	$ 359,642	MEANS 32.12.16.13.0380	
Dense graded aggregate base course (4-inch)	15,349	SY	$ 30.09	$ 461,841	MEANS 32.12.16.13	
Storm water inlets	16	EA	$ 11,638	$ 186,203	Source 4	
Install Storm drains	4,000	LF	$ 150.00	$ 600,000		
Install Sanitary Sewer	1,600	LF	$ 80.00	$ 128,000		
Install Traffic Control	1	LS	$ 30,000.00	$ 30,000		
Install Electrical	3,000	LF	$ 800.00	$ 2,400,000		
Install Waterlines	4,000	LF	$ 75.00	$ 300,000		
Install Communications	2,000	LF	$ 50.00	$ 100,000		
Install Street Lighting	1,400	LF	$ 200.00	$ 280,000		
Import Fill- Furnish and install	14,300	CY	$ 45.00	$ 643,500	Assume 5 foot depth	
Concrete island (4" thick)	1989	SY	$ 36.00	$ 71,604	MEANS 32.06.10.10	
Concrete vertical curb (9" x 20")	6,768	LF	$ 24.00	$ 162,432	MEANS 32.06.10.10	
Dust suppression	15	DY	$ 820	$ 12,300	MEANS 31.23.23.18.4500	Not required for Asphalt work
SUBTOTAL				*$ 6,205,637*		
Compliance Monitoring and Health & Safety						
Environmental Controls	1	LS	$ 12,772	$ 12,772	Source 4	
Install Decon Shed for workers (Mobilization & Demobilization)	1	LS	$ 500.00	$ 500	Source 3	
Decon Shed	18	MO	$ 1,043	$ 18,765	18 months- demo & ISS	
Air Monitoring	396	DY	$ 3,000	$ 1,188,000	Source 4 + CH2M H&S	
PPE Provisions for Workers (Initial)	20	EA	$ 252	$ 5,038	Source 4	10 labor, 4 operator, 4 trucks, 2 supervisor
PPE Provisions for Workers (Worker-Days)	7,920	EA	$ 21	$ 166,320	Source 4 + CH2M H&S	
SUBTOTAL				*$ 1,391,395*		
CAPITAL SUBTOTAL - SOIL				$ 247,629,849		
Contingency	25%			$ 61,907,462	10% Scope + 10% Bid, USEPA 2000, p.5-10 & 5-11	
SUBTOTAL				$ 309,537,312		
Project Management	5%			$ 15,476,866	**USEPA 2000, p. 5-13, >$10M**	
Remedial Design	6%			$ 18,572,239	**USEPA 2000, p. 5-13, >$10M**	
Construction Management	6%			$ 18,572,239	**USEPA 2000, p. 5-13, >$10M**	
SUBTOTAL				$ 52,621,343		
Contractor Fees						
ODC & Subs	5%		$ 309,537,312	$ 15,476,866		
Labor	10%	max	$ 52,621,343	$ 5,262,134		
SUBTOTAL				$ 20,739,000		
TOTAL CAPITAL COST - SOIL				**$ 382,900,000**		

GROUNDWATER

General

Preconstruction Investigations						
Pump Test	1	LS	$ 230,000	$ 230,000		
Updates to the Groundwater Model	1	LS	$ 20,000	$ 20,000		
Bench-Scale Testing (Arsenic and NAPL)	2	EA	$ 75,000	$ 150,000		
SUBTOTAL				*$ 400,000*		
Replacement Monitoring Wells						
Soil Borings	480	FT	$ 47	$ 22,320		Assumes 16 wells at 30-ft deep
2-inch PVC Well Casing	480	FT	$ 15	$ 7,109		
2-inch PVC Well Screen	160	FT	$ 25	$ 4,003		Assumes 10-ft screen
2-inch PVC Riser	320	FT	$ 15	$ 4,739		
Well cuttings disposal	16	EA	$ 100	$ 1,600		Assumes one 55-gal drum per well
Well development	16	EA	$ 1,600	$ 25,600		
SUBTOTAL				$ 65,371		
Mobilization/Demobilization	5%			$ 3,269	Source 3	
Subcontractor General Conditions	25%			$ 16,343	Source 3	
SUBTOTAL				*$ 84,982*		

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Comprehensive Remediation Alternative 4: In Situ Solidification/Stabilization — COST ESTIMATE SUMMARY - DRAFT

Temporary Sheet pile at Shoreline					
Remove Concrete Decking	2,500	SF	$ 15	$ 37,500	Envirocon ROM estimate
Rip-rap Removal	1,040	CY	$ 25	$ 26,000	Envirocon ROM estimate
Temporary Sheet piling - Shoreline	10,100	SF	$ 80	$ 808,000	Envirocon ROM estimate Turbidity Barrier only, includes removal
SUBTOTAL				$ 871,500	
Mobilization/Demobilization	15%			$ 130,725	Source 3
Subcontractor General Conditions	15%			$ 130,725	Lower % due to Envirocon quote
SUBTOTAL				*$ 1,132,950*	
CAPITAL SUBTOTAL - GROUNDWATER				$ 1,617,932	
Contingency	25%			$ 404,483	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
SUBTOTAL				$ 2,022,415	
Project Management	5%			$ 101,121	**USEPA 2000, p. 5-13, $2M- $10M**
Remedial Design	8%			$ 161,793	**USEPA 2000, p. 5-13, $2M- $10M**
Construction Management	6%			$ 121,345	**USEPA 2000, p. 5-13, $2M- $10M**
SUBTOTAL				$ 384,259	
Contractor Fees					
ODC & Subs	5%		$ 2,022,415	$ 101,121	
Labor	10%	max	$ 384,259	$ 38,426	
SUBTOTAL				$ 139,547	
TOTAL CAPITAL COST - GROUNDWATER				**$ 2,550,000**	

OPERATIONS AND MAINTENANCE COST

SOIL

DESCRIPTION	QTY	UNIT	COST	TOTAL	NOTES
					Assumes 1% of area requires repair annually, cap costs are based on repaving and maintaining the soil cap at Quanta
Asphalt Repair	1	LS	$ 38,119	$ 38,119	
Site Inspection and Repair Report	1	LS	$ 2,000	$ 2,000	Biennial Report to NJDEP
SUBTOTAL				$ 40,119	
Contingency	25%			$ 10,030	10% Scope + 15% Bid
SUBTOTAL				*$ 50,149*	
Project Management	5%			$ 2,507	
Technical Support	25%			$ 12,537	
TOTAL ANNUAL O&M COST				**$ 65,200**	

GROUNDWATER

DESCRIPTION	YEAR	QTY	UNIT	COST	TOTAL	NOTES
Groundwater Monitoring						
Groundwater Samples		40	EA	$ 600	$ 24,000	VOCs, Arsenic, Iron
QC Samples		5	EA	$ 600	$ 3,000	
Groundwater Sampling, Level D						
Labor		300	HR	$ 80	$ 24,000	CH2M Est. - 3 persons for 5 days
Equipment - meters		1	LS	$ 2,000	$ 2,000	CH2M Est.
Consumables		1	LS	$ 3,000	$ 3,000	CH2M Est.
Data Validation		96	HR	$ 100	$ 9,600	CH2M Est.
Reporting		240	HR	$ 100	$ 24,000	CH2M Est.
SUBTOTAL					$ 89,600	
Allowance for Misc. Items		10%			$ 8,960	
SUBTOTAL					$ 98,560	
Contingency		15%			$ 14,784	10% Scope + 5% Bid
SUBTOTAL					$ 113,344	
TOTAL ANNUAL O&M COST Year 1					**$ 453,000**	Quarterly for first year
TOTAL ANNUAL O&M COST Year 2 to 5					**$ 113,000**	Annual for Years 2 to 5

PERIODIC COST

SOIL / GROUNDWATER

DESCRIPTION	YEAR	QTY	UNIT	COST	TOTAL	NOTES
5 year Review	5	1	LS	$ 15,000	$ 15,000	CH2M HILL support to EPA Review Document Preparation
				Total	$ 15,000	
TOTAL PERIODIC COST					**$ 15,000**	

PRESENT VALUE

SOIL / GROUNDWATER

Discount Rate = 7.0%

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	PRESENT VALUE	NOTES
CAPITAL COST (Soil, Groundwater)	0	$ 385,450,000	$ 385,450,000	1.000	$ 385,450,000	
ANNUAL O&M COST (Year 1) Soil and Groundwater	0 to 1	$ 518,200	$ 518,200	0.935	$ 484,299	
ANNUAL O&M COST (Year 2-5) Soil and Groundwater	2 to 5	$ 712,800	$ 178,200	3.166	$ 564,113	
PERIODIC COST	5	$ 15,000	$ 15,000	0.713	$ 10,695	
		$ 386,696,000			$ 386,509,107	

TOTAL PRESENT VALUE OF ALTERNATIVE 4 $ 386,500,000

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
2b. R.S. Means Company. Heavy Construction 2008. 22nd Edition.
2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
3. Historical CH2M HILL project cost information
4. Calculations using Historical CH2M HILL project cost information (separate worksheet)

400533

Comprehensive Remediation Alternative 6: Excavation

COST ESTIMATE SUMMARY - DRAFT

Site: Quanta Resources Site-Edgewater, New Jersey
Media Groundwater, Soil and NAPL
Phase: Draft TI Waiver
Base Year: 2010
Date: 2/11/2010

Description:

NAPL	NAPL zones and tar boils throughout OU1 would be excavated and disposed of offsite. Excavation would require dewatering to achieve depths greater than 4 ft. Water generated from dewatering activities would be treated on site prior to discharge to the Hudson River. Following excavation the site would be backfilled and compacted with clean material to grade. Includes demolition of building, roadways, and parking areas within OU1.
Arsenic	Arsenic areas throughout OU1 would be excavated and disposed of offsite. Excavation would require dewatering to achieve depths greater than 4 ft. Water generated from dewatering activities would be treated on site prior to discharge to the Hudson River. Following excavation the site would be backfilled and compacted with clean material to grade. Including under roadways, the access ramp on the former Celotex property, and parking areas.
Residual Soil	In situ solidification/stabilization of residual soils throughout OU1. The ISS areas would be covered with either a single-layer engineered cap (i.e., asphalt or a vegetative cap). ICs would be established to place restrictions on future land use and control future construction and redevelopment activities.
Groundwater	All sources to groundwater would be treated, therefore, only groundwater monitoring would be performed following remedial activities.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	Costing Basis	Assumptions
SOIL						
General Site Work						
Mobilization/Demobilization	5%		$ 433,760,229	$ 21,688,011		Calculate as 5% of capital cost
Subcontractor General Conditions	20%		$ 433,760,229	$ 86,752,046		Calculate as 10% of capital cost
SUBTOTAL				*$ 108,440,057*		
Site Establishment						
Survey	200	DY	$ 1,500	$ 300,000	CCI Historical	
Utility Survey, Geophysical Survey	1	LS	$ 190,000	$ 190,000	CH2M Est.	
Fencing	6,000	LF	$ 15	$ 90,000	CCI Historical	
Trailer Installation & Setup	2	EA	$ 3,000	$ 6,000	CH2M Est.	Tie-downs, stairs, power
Support Area Establishment and Site Offices	36	MO	$ 4,300	$ 154,800	CH2M Est.	Includes shed, utilities, lavatories
SUBTOTAL				*$ 740,800*		
Institutional Controls (Quanta, 115 River Road, Edgewater, Block 93 North, Block 93 Central, Block 93 South, River Road ROW, Gorge Road ROW, Former Lever Bros)						
Deed Notices (1 for each property)	9	LS	$ 25,000	$ 225,000	CH2M Est.	Draft deed covenant, coordination with regulators, public involvement, professional services, and filing deed covenant
Security Service	36	MO	$ 12,000	$ 432,000	CH2M Est.	
SUBTOTAL				*$ 657,000*		
Clearing & Vegetation/Debris Disposal						
Site Clearing & Disposal (Quanta Property)						
Temporary erosion controls (silt fencing)	3,000	LF	$ 1.28	$ 3,852	MEANS 31.25.13.10.1100	Surrounding property boundary
Clear and Grub Heavy Brush & Trees (includes chipper)	5.5	AC	$ 8,203	$ 44,851	MEANS 31.11.10.10.0260	Clear & grub brush, including stumps, from the Quanta site
Tank pad, concrete & debris removal @ NZ-1 and NZ-2	31,422	TON	$ 128	$ 4,011,001	MEANS 02.41.13.17.5500	Demolition of debris in top 4-ft in NZ-2 and 2-ft throughout NZ-1 (assumes 1.65 ton/cy)
Asphalt removal	3,969	SY	$ 3.76	$ 14,925	Source 3	Assumes 3" thick asphalt to be cleared from 15% of Quanta
Subsurface piping abandonment	1	LS	$ 250,000	$ 250,000		Engineer's Estimate
Offsite disposal of cleared materials, concrete (including transportation to < 50 miles)	19,639	CY	$ 130	$ 2,553,027		
Asphalt Disposal	437	CY	$ 25	$ 10,925	Source 3	
Dust suppression	60	DY	$ 820	$ 49,201	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
SUBTOTAL				*$ 6,937,781*		
Site Clearing & Disposal (Block 93, 115 River Road)						
Temporary erosion controls (silt fencing)+B26	2,100	LF	$ 1.28	$ 2,696	MEANS 31.25.13.10.1100	Surrounding property boundary
Asphalt removal	26,520	SY	$ 3.76	$ 99,716	Source 3	Assumes 3" thick asphalt to be cleared from Block 93 and 115 River Road
Asphalt Disposal	2,917	CY	$ 25	$ 72,925	Source 3	
Dust suppression	5	DY	$ 820	$ 4,100	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
SUBTOTAL				*$ 179,438*		
Site Clearing & Disposal (Edgewater - Arsenic Area)						
Temporary erosion controls (silt fencing)	1,500	LF	$ 1.28	$ 1,926	MEANS 31.25.13.10.1100	Surrounding property boundary
Concrete removal & sizing to less than 2'	6,061	TON	$ 118	$ 715,159	MEANS 02.41.13.17.5500	Concrete demolition of access ramp, assumes 2-ft of concrete
Asphalt removal	6,361	SY	$ 3.76	$ 23,918	Source 3	Assumes 3" thick asphalt to be cleared from area above the arsenic liner
Offsite disposal of concrete (including transportation to < 50 miles)	3,367	CY	$ 130	$ 437,715	MEANS 33-19-7270	Assumes non-HW landfill
Asphalt Disposal	700	CY	$ 25	$ 17,500	Source 3	
Dust suppression	40	DY	$ 820	$ 32,801	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Dig Permits & Utility Markout	10	DY	$ 3,000	$ 30,000	Source 3	
Excavation, stockpile and backfill of 10-ft of soils above the existing arsenic liner	21,204	CY	$ 35	$ 750,473	MEANS 17-03-0276	Assumes material will be replaced following the completion of arsenic stabilization
Temporary Access	1	allow	$ 65,000	$ 65,000		
SUBTOTAL				*$ 2,074,491*		
Site Clearing & Disposal (Edgewater)						
Temporary erosion controls (silt fencing)	2,000	LF	$ 1.28	$ 2,568	MEANS 31.25.13.10.1100	Surrounding property boundary
Concrete removal & sizing to less than 2'	6,438	TON	$ 118	$ 759,684	MEANS 02.41.13.17.5500	
Asphalt removal	14,250	SY	$ 3.76	$ 53,580	Source 3	Assumes 3" thick asphalt to be cleared from 50% of area above the arsenic liner
Offsite disposal of concrete (including transportation to < 50 miles)	3,577	CY	$ 130	$ 464,967	MEANS 33-19-7270	Assumes non-HW landfill
Asphalt Disposal	1568	CY	$ 25	$ 39,200	Source 3	
Dust suppression	30	DY	$ 820	$ 24,600	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Dig Permits & Utility Markout	5	DAY	$ 3,000	$ 15,000	Source 3	
Excavation and stockpile of 10-ft of backfill	4,750	CY	$ 30	$ 141,075	MEANS 17-03-0276	
Temporary Access	1	allow	$ 65,000	$ 65,000		
SUBTOTAL				*$ 1,565,674*		
Site Clearing & Disposal (Lever Brothers)						
Temporary erosion controls (silt fencing)	750	LF	$ 1.28	$ 963	MEANS 31.25.13.10.1100	Surrounding property boundary
Asphalt removal	1,505	SY	$ 3.76	$ 5,660	Source 3	
Asphalt Disposal	166	CY	$ 25	$ 4,150	Source 3	
Dust suppression	7	DY	$ 820	$ 5,740	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Dig Permits & Utility Markout	1	DY	$ 3,000	$ 3,000	Source 3	
SUBTOTAL				*$ 19,514*		
Demolition of 115 River Road						
Temporary relocation of tenants	1	LS	$ 2,000,000	$ 2,000,000	Assumes 60 businesses - cost provided by Honeywell real estate group	
Loss of rent	1	LS	$ 7,000,000	$ 7,000,000	Assumes 3 yrs - cost provided by Honeywell real estate group	
Differential in rent for tenants	1	LS	$ 500,000	$ 500,000		
Building demolition	1	LS	$ 2,000,000	$ 2,000,000	Assumes bldg 86,000 ft^2 - cost provided by Honeywell real estate group	
Building reconstruction	1	LS	$ 39,000,000	$ 39,000,000	Cost provided by Honeywell real estate group	
SUBTOTAL				*$ 50,500,000*		
Temporary Shutdown of Hotel on Former Celotex						
Loss of business	1	LS	$ 5,365,500	$ 5,365,500	Assumes 58% occupancy at $14700/night for 1 year	
SUBTOTAL				*$ 5,365,500*		
Demolition of Jonas Restaurant						
Temporary relocation of business	1	LS	$ 300,000	$ 300,000	Assumes businesses moved twice - cost scaled from 115 River Road	
Loss of rent	1	LS	$ 900,000	$ 900,000	Assumes 3 yrs - cost scaled from 115 River Road	
Differential in rent for tenants	1	LS	$ 100,000	$ 100,000	Cost provided by Honeywell real estate group	
Building demolition	1	LS	$ 300,000	$ 300,000	Assumes bldg 10,000 ft^2 - **cost scaled from 115 River Road**	
Building reconstruction	1	LS	$ 4,600,000	$ 4,600,000	Cost scaled from 115 River Road	
SUBTOTAL				*$ 6,200,000*		
Demolition of Medical Arts Building						
Temporary relocation of tenants	1	LS	$ 500,000	$ 500,000	Assumes businesses moved twice - cost scaled from 115 River Road	
Loss of rent	1	LS	$ 1,500,000	$ 1,500,000	Assumes 3 yrs - cost scaled from 115 River Road	
Differential in rent for tenants	1	LS	$ 200,000	$ 200,000	Cost provided by Honeywell real estate group	
Building demolition	1	LS	$ 500,000	$ 500,000	Assumes bldg 18,000 ft^2 - cost scaled from 115 River Road	
Building reconstruction	1	LS	$ 8,200,000	$ 8,200,000	Cost scaled from 115 River Road	
SUBTOTAL				*$ 10,900,000*		
Demolition of Block 93 Central Buildings						
Building demolition	1	LS	$ 1,200,000	$ 1,200,000	Assumes bldg 49,000 ft^2 - cost scaled from 115 River Road	
Building reconstruction	1	LS	$ 22,300,000	$ 22,300,000	Cost scaled from 115 River Road	
SUBTOTAL				*$ 23,500,000*		
Demolition of River Road and Intersection of River Road and Gorge Road						
Temporary erosion controls (silt fencing)	1,400	LF	$ 1.28	$ 1,798	MEANS 31.25.13.10.1100	Surrounding property boundary
Traffic Detour	8	MO	$ 35,400	$ 283,200	2 FTE plus arrow boards and barricades	
Utility Shutdowns	1	LS	$ 80,000	$ 80,000	Assumes bypass not required.	
Remove Storm drains	4,000	LF	$ 20	$ 80,000		
Remove Sanitary Sewer	1,600	LF	$ 20	$ 32,000		
Remove Traffic Control	1	LS	$ 8,000	$ 8,000		
Remove Electrical	3,000	LF	$ 18	$ 54,000		
Remove Waterlines	4,000	LF	$ 15	$ 60,000		
Remove Communications	2,000	LF	$ 10	$ 20,000		
Remove Street Lighting	1,400	LF	$ 30	$ 42,000		
Disposal of Soil	14,300	CY	$ 130	$ 1,859,000	Assume 5 foot depth	
Concrete removal	10,284	SY	$ 3.76	$ 38,667	MEANS 02.41.13.17	
Concrete disposal	762	CY	$ 25	$ 19,044	Source 3	Assumes 2-ft thick concrete to be cleared
Dust suppression	10	DY	$ 820	$ 8,200	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Dig Permits & Utility Markout	2	DY	$ 3,000	$ 6,000	Source 3	
SUBTOTAL				*$ 2,591,909*		

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Comprehensive Remediation Alternative 6: Excavation — COST ESTIMATE SUMMARY - DRAFT

Item	Quantity	Unit	Unit Cost	Cost	Source	Notes
Excavation, Backfilling, & Soil Disposal						
Excavation of Tar Boils & NAPL Zones NZ-1 and NZ-3						
Dig Permits & Utility Markout	7	DAY	$ 3,000	$ 21,000	Source 3	
Excavation of OU1	960,000	CY	$ 30	$ 28,800,000	MEANS 17-03-0276	Assumes direct loading of materials, mult excavations
Certified clean fill for backfilling excavated areas	1,152,000	CY	$ 18	$ 20,736,000	MEANS 17-03-0423	Assumes 1.2x excavated material required for compaction
Dust suppression	670	DY	$ 820	$ 549,400	MEANS 31.23.23.18.4500	Concurrent site activities/dust control
Odor suppression	670	DY	$ 1,000	$ 670,000	Source 3	Total crew days, multiple crews to make schedule
On-site stabilization of excavated contaminated soils with Portland Cement	1,584,000	TON	$ 70	$ 110,880,000	Source 3	Includes material & cost to incorporate so that soils meet TCLP limits for non-hazardous landfill, assume 1.65 Tons/CY
Disposal of stabilized soil - Non-Haz Waste	1,104,000	CY	$ 130	$ 143,520,000	MEANS 33-19-7270	Assumes 100% of material for disposal as non-hazardous waste after stabilization (15% increase in volume from stabilization material)
Confirmation Sampling	1,920	EA	$ 350	$ 672,000	CH2M HILL Est.	1 sample per 500 cy of excavated material
Shoring Around Hotel Building	500	LF	$ 450	$ 225,000	CH2M HILL Est.	4'-5' depth
SUBTOTAL				*$ 305,848,400*		
Restoration						
Restoration of Block 93 North, Block 93 Central, Block 93 South						Assume no clean fill needed, no clearing unless included above, asphalt removal & disposal included above
Fine grading	16,666	SY	$ 1.42	$ 23,693	MEANS 17-03-0101	Assume no fill needed for grading
Gravel Base, 6 inches	2,780	CY	$ 53.47	$ 148,658	MEANS 32.11.23.23.1511	
Storm water control (3' x 3' culverts, rip-rap)	8	EA	$ 11,638	$ 93,101	Source 4	Included 2 storm water control systems per capped property
Asphalt stabilized binder course, 2" thick	16,666	SY	$ 22.89	$ 381,461	MEANS 32.12.16.13.0120	
Asphalt wear course, 2" thick	16,666	SY	$ 23.43	$ 390,502	MEANS 32.12.16.13.0380	
Install Asphalt Curb/Berm on Perimeter	1,000	LF	$ 11.04	$ 11,040	MEANS 32.16.19.10.0150	
SUBTOTAL				*$ 1,048,456*		
Restoration of 115 River Road Property						
Asphalt removal	7,059	SY	$ 3.76	$ 26,543	Source 3	3" thick asphalt
Fine grading	7,059	SY	$ 1.42	$ 10,036	MEANS 17-03-0101	Assume no fill needed for grading
Gravel Base, 6 inches	1,180	CY	$ 53.47	$ 63,100	MEANS 32.11.23.23.1511	
Storm water control (3' x 3' culverts, rip-rap)	2	EA	$ 11,638	$ 23,275	Source 4	Included 2 storm water control systems per capped property
Asphalt stabilized binder course, 2" thick	7,059	SY	$ 22.89	$ 161,583	MEANS 32.12.16.13.0120	
Asphalt wear course, 2" thick	7,059	SY	$ 23.43	$ 165,412	MEANS 32.12.16.13.0380	
Install Asphalt Curb/Berm on Perimeter	2,100	LF	$ 11.04	$ 23,184	MEANS 32.16.19.10.0150	
Asphalt disposal (recycled)	590	CY	$ 25	$ 14,750	Source 3	3" thick asphalt
SUBTOTAL				*$ 487,884*		
Restoration of Block 94 and 92.01						
Asphalt removal	3,668	SY	$ 3.76	$ 13,792	Source 3	3" thick asphalt
Fine grading	3,668	SY	$ 1.42	$ 5,215	MEANS 17-03-0101	Assume no fill needed for grading
Gravel Base, 6 inches	68	CY	$ 53.47	$ 3,632	MEANS 32.11.23.23.1511	
Storm water control (3' x 3' culverts, rip-rap)	4	EA	$ 11,638	$ 46,551	Source 4	Included 2 storm water control systems per capped property
Asphalt stabilized binder course, 2" thick	3,668	SY	$ 22.89	$ 83,957	MEANS 32.12.16.13.0120	
Asphalt wear course, 2" thick	3,668	SY	$ 23.43	$ 85,947	MEANS 32.12.16.13.0380	
Install Asphalt Curb/Berm on Perimeter	1,239	LF	$ 11.04	$ 13,675	MEANS 32.16.19.10.0150	
Asphalt disposal (recycled)	1,239	CY	$ 25	$ 30,967	Source 3	3" thick asphalt
SUBTOTAL				*$ 283,734*		
Cover for Quanta and Lever Bros. Property						
Rough grading	27,970	SY	$ 5.15	$ 144,048	MEANS 17-03-0101	
Fine grading	27,970	SY	$ 1.42	$ 39,765	MEANS 17-03-0101	
Fill to match grade in adjacent properties	500	CY	$ 18	$ 8,851	MEANS 17-03-0423	
Protective layer, 6" compacted soil subgrade	4,660	CY	$ 18	$ 82,494	MEANS 17-03-0423	
HDPE Liner, 40 mil thick	27,970	SY	$ 15	$ 431,584	ECHOS 33.08.0572	
Drainage layer, 6" granular soil (assume gravel)	4,660	CY	$ 53.47	$ 249,190	MEANS 32.11.23.23.1511	
Grade, Place Geotextile filter fabric	27,970	SY	$ 2.00	$ 55,941	Source 3	
Hydroseed	251,700	SF	$ 0.07	$ 17,619	Source 3	
SUBTOTAL				*$ 1,029,491*		
Restoration of Celotex						
Rough grading	14,250	SY	$ 5.15	$ 73,388	MEANS 17-03-0101	
Fine grading	14,250	SY	$ 1.42	$ 20,259	MEANS 17-03-0101	
Gravel Base, 6 inches	2,380	CY	$ 53.47	$ 127,269	MEANS 32.11.23.23.1511	
Storm water control (3' x 3' culverts, rip-rap)	5	EA	$ 11,638	$ 58,188	Source 4	Included 2 storm water control systems per capped property
Asphalt stabilized binder course, 2" thick	14,250	SY	$ 22.89	$ 326,168	MEANS 32.12.16.13.0120	
Asphalt wear course, 2" thick	14,250	SY	$ 23.43	$ 333,899	MEANS 32.12.16.13.0380	
Install Asphalt Curb/Berm on Perimeter	2,100	LF	$ 11.04	$ 23,184	MEANS 32.16.19.10.0150	
SUBTOTAL				*$ 962,355*		
Replacement of Access Ramp and Parking Lots (Edgewater)						Assume no clean fill needed, no clearing unless included above, asphalt removal & disposal included above
Surveying	10	DY	$ 1,500	$ 15,000		
Backfilling and compaction of excavated material	21,204	CY	$ 18	$ 375,358	MEANS 17-03-0423	Assumes 1.2x excavated material required for compaction
Rough site grading	8,275	SY	$ 5.15	$ 42,580	MEANS 17-03-0101	Assume no fill needed for grading
Fine grading	8,275	SY	$ 1.42	$ 11,764	MEANS 17-03-0101	Assume no fill needed for grading
Surface course (2-inch)	8,275	SY	$ 22.89	$ 189,407	MEANS 32.12.16.13.0120	Asphalt pricing includes haul
Stabilized base course (2.5-inch)	8,275	SY	$ 23.43	$ 193,896	MEANS 32.12.16.13.0380	Concurrent site activities/dust control
Dense graded aggregate base course (4-inch)	8,275	SY	$ 30.09	$ 248,995	MEANS 32.12.16.13	
Replace Access Ramp	3,030	CY	$ 1,200	$ 3,636,000	CH2M Hill Estimate	
Dust suppression	60	DY	$ 820	$ 49,201	MEANS 32.12.16.13.0120	
Storm water inlets	2	EA	$ 11,638	$ 23,275	MEANS 32.12.16.13.0380	
Concrete Curb on Perimeter	2,500	LF	$ 11	$ 27,600	MEANS 32.16.19.10.0150	
SUBTOTAL				*$ 4,813,075*		
Replacement of River Road and Intersection of River and Gorge Roads						Assume no clean fill needed, no clearing unless included above, asphalt removal & disposal included above
Surveying	12	DY	$ 1,500	$ 18,000		
Rough site grading	15,349	SY	$ 5.15	$ 78,978	MEANS 17-03-0101	Assume no fill needed for grading
Fine grading	15,349	SY	$ 1.42	$ 21,821	MEANS 17-03-0101	Assume no fill needed for grading
Surface course (2-inch)	15,349	SY	$ 22.89	$ 351,316	MEANS 32.12.16.13.0120	Asphalt pricing includes haul
Stabilized base course (2.5-inch)	15,349	SY	$ 23.43	$ 359,642	MEANS 32.12.16.13.0380	
Dense graded aggregate base course (4-inch)	15,349	SY	$ 30.09	$ 461,841	MEANS 32.12.16.13	
Storm water inlets	16	EA	$ 11,638	$ 186,203	Source 4	
Install Storm drains	4,000	LF	$ 150.00	$ 600,000		
Install Sanitary Sewer	1,600	LF	$ 80.00	$ 128,000		
Install Traffic Control	1	LS	$ 30,000.00	$ 30,000		
Install Electrical	3,000	LF	$ 800.00	$ 2,400,000		
Install Waterlines	4,000	LF	$ 75.00	$ 300,000		
Install Communications	2,000	LF	$ 50.00	$ 100,000		
Install Street Lighting	1,400	LF	$ 200.00	$ 280,000		
Import Fill- Furnish and install	14,300	CY	$ 45.00	$ 643,500	Assume 5 foot depth	
Concrete island (4" thick)	1989	SY	$ 36.00	$ 71,604	MEANS 32.06.10.10	
Concrete vertical curb (9" x 20")	6,768	LF	$ 24.00	$ 162,432	MEANS 32.06.10.10	
Dust suppression	15	DY	$ 820	$ 12,300	MEANS 31.23.23.18.4500	Not required for Asphalt work
SUBTOTAL				*$ 6,205,637*		
Compliance Monitoring and Health & Safety						
Environmental Controls	1	LS	$ 12,772	$ 12,772	Source 4	
Install Decon Shed for workers (Mobilization & Demobilization)	1	LS	$ 500.00	$ 500	Source 3	
Decon Shed	24	MO	$ 1,043	$ 25,021	Source 4	
Air Monitoring	528	DY	$ 3,000	$ 1,584,000	Source 4 + CH2M H&S	
PPE Provisions for Workers (Initial)	20	EA	$ 252	$ 5,038	Source 4	10 labor, 4 operator, 4 trucks, 2 supervisor
PPE Provisions for Workers (Worker-Days)	10,560	EA	$ 21	$ 221,760	Source 4 + CH2M H&S	
SUBTOTAL				*$ 1,849,091*		
CAPITAL SUBTOTAL - SOIL				$ 542,200,286		
Contingency	25%			$ 135,550,071	10% Scope + 10% Bid, USEPA 2000, p.5-10 & 5-11	
SUBTOTAL				$ 677,750,357		
Project Management	5%			$ 33,887,518	**USEPA 2000, p. 5-13, >$10M**	
Remedial Design	6%			$ 40,665,021	**USEPA 2000, p. 5-13, >$10M**	
Construction Management	6%			$ 40,665,021	**USEPA 2000, p. 5-13, >$10M**	
SUBTOTAL				$ 115,217,561		
Contractor Fees						
ODC & Subs	5%		$ 677,750,357	$ 33,887,518		
Labor	10%	max	$ 115,217,561	$ 11,521,756		
SUBTOTAL				$ 45,409,274		
TOTAL CAPITAL COST - SOIL				**$ 838,380,000**		
GROUNDWATER						
General						
Preconstruction Investigations						
Pump Test	1	LS	$ 230,000	$ 230,000		
Updates to the Groundwater Model	1	LS	$ 20,000	$ 20,000		
Bench-Scale Testing (Arsenic and NAPL)	2	EA	$ 75,000	$ 150,000		
SUBTOTAL				*$ 400,000*		
Replacement Monitoring Wells						
Soil Borings	480	FT	$ 47	$ 22,320		Assumes 16 wells at 30-ft deep
2-inch PVC Well Casing	480	FT	$ 15	$ 7,109		
2-inch PVC Well Screen	160	FT	$ 25	$ 4,003		Assumes 10-ft screen
2-inch PVC Riser	320	FT	$ 15	$ 4,739		
Well cuttings disposal	16	EA	$ 100	$ 1,600		Assumes one 55-gal drum per well
Well development	16	EA	$ 1,600	$ 25,600		
SUBTOTAL				*$ 65,371*		
Mobilization/Demobilization	5%			$ 3,269	Source 3	
Subcontractor General Conditions	25%			$ 16,343	Source 3	
SUBTOTAL				*$ 84,982*		

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Comprehensive Remediation Alternative 6: Excavation — COST ESTIMATE SUMMARY - DRAFT

DESCRIPTION	QTY	UNIT	COST	TOTAL	NOTES	
Cutoff Wall at Shoreline						
Remove Concrete Decking	2,500	SF	$ 15	$ 37,500	Envirocon ROM estimate	
Rip-rap Removal	1,040	CY	$ 25	$ 26,000	Envirocon ROM estimate	
Sealed Sheet piling - Shoreline	22,400	SF	$ 127	$ 2,844,800	Envirocon ROM estimate	
SUBTOTAL				$ 2,908,300		
Mobilization/Demobilization	15%			$ 436,245	Source 3	
Subcontractor General Conditions	15%			$ 436,245	Lower % due to Envirocon quote	
SUBTOTAL				*$ 3,780,790*		
Wastewater Treatment Plant to Treat Excavated Water						
Pumping and Equalization of Influent Water						
8,000 gallon polypropylene equalization tanks	2	EA	$ 12,605	$ 25,211	Source 3	Provides 8-hrs of storage at 100 gpm
Sludge pump	1	EA	$ 3,820	$ 3,820	Source 3	
Off-gas pump	1	EA	$ 1,322	$ 1,322	Source 3	
50 GPM effluent pump (MAX @ 65'TDH)	4	EA	$ 4,221	$ 16,883	Source 3	
NAPL pump	1	EA	$ 3,864	$ 3,864	Source 3	
Chemical feed systems (caustic and acid)	2	EA	$ 3,130	$ 6,260	Source 3	
SUBTOTAL				$ 57,360		
Mobilization/Demobilization	5%			$ 2,868	Source 3	
Subcontractor General Conditions	25%			$ 14,340	Source 3	
SUBTOTAL				*$ 74,568*		
Removal of NAPLs and Solids						
Oil-water separator, 50 gpm	1	EA	$ 16,910	$ 16,910	ECHOS 19.04.0412	
Packaged 1,500 Gallon Steel Product Tank	1	EA	$ 4,950	$ 4,950	ECHOS 19.04.0604	
Packaged 20 gpm Oil Pump out unit w/controls	1	EA	$ 7,670	$ 7,670	ECHOS 33.13.1211	
50 GPM effluent pump (one in operation and one in stand-by) (MAX@ 65'TDH)	2	EA	$ 4,221	$ 8,442	Source 3	
Chemical feed systems (caustic, acid, polymer, hydrogen peroxide, and ferric chloride)	5	EA	$ 3,130	$ 15,650	Source 3	
SUBTOTAL				$ 53,622		
Mobilization/Demobilization	5%			$ 2,681	Source 3	
Subcontractor General Conditions	25%			$ 13,405	Source 3	
SUBTOTAL				*$ 69,708*		
Advanced oxidation						
Flocculation tanks connected in series	4	EA	$ 4,714	$ 18,855	Source 3	
Chemical feed systems (caustic, acid, polymer, hydrogen peroxide, and ferric chloride)	5	EA	$ 3,130	$ 15,650	Source 3	
Waste sludge pumps (Non-clogging with double vortex impellers to handle heavy sludge)	2	EA	$ 3,864	$ 7,728	Source 3	
SUBTOTAL				$ 42,233		
Mobilization/Demobilization	5%			$ 2,112	Source 3	
Subcontractor General Conditions	25%			$ 10,558	Source 3	
SUBTOTAL				*$ 54,903*		
Solid-liquid Separation						
Inclined plate clarifier (0.25 GPM/SF of area)	3	EA	$ 26,520	$ 79,560	ECHOS 33.13.0414	
100 GPM effluent pump for use with plate clarifier	1	EA	$ 6,211	$ 6,211	Source 3	
Sludge pump for use with plate clarifier	1	EA	$ 3,130	$ 3,130	Source 3	
Bag filters	2	EA	$ 800	$ 1,600	Source 3	
Offgas pumps for use with bag filters	2	EA	$ 1,500	$ 3,000	Source 3	
Effluent pumps for use with bag filters	2	EA	$ 4,200	$ 8,400	Source 3	
Liquid waste pump for use with sludge settling tank	1	EA	$ 4,200	$ 4,200	Source 3	
Filter press, 95% removal efficiency	2	EA	$ 90,100	$ 180,200	ECHOS 33.33.3013	10 CF w/sludge tanks, pumps, mixers, sludge cart
SUBTOTAL				$ 286,301		
Mobilization/Demobilization	5%			$ 14,315	Source 3	
Subcontractor General Conditions	25%			$ 71,575	Source 3	
SUBTOTAL				*$ 372,192*		
Effluent Polishing						
Packaged 36,000 GPD water treatment plant	2	EA	$ 32,400	$ 64,800	ECHOS 19.01.0807	Includes GAC, pumps, tanks
Concrete Wet Well, 12'x36"	4	EA	$ 9,200	$ 36,800	ECHOS 19.02.0304	
Packaged Lift Station (70 gpm)	4	EA	$ 9,950	$ 39,800	ECHOS 19.02.0304	
Ion exchange units (one in operation and one standby and/or in regeneration phase)	2	EA	$ 10,000	$ 20,000	CH2M HILL Est.	
SUBTOTAL				$ 161,400		
Mobilization/Demobilization	5%			$ 8,070	Source 3	
Subcontractor General Conditions	25%			$ 40,350	Source 3	
SUBTOTAL				*$ 209,820*		
Building & Controls						
Building / HVAC / Electrical	1	EA	$ 150,000	$ 150,000	Source 3	
SCADA Computer Control System	1	LS	$ 400,000	$ 400,000	CH2M HILL Est.	
SUBTOTAL				$ 550,000		
Mobilization/Demobilization	5%			$ 27,500	Source 3	
Subcontractor General Conditions	25%			$ 137,500	Source 3	
SUBTOTAL				*$ 715,000*		
Piping, Instrumentation, & Equipment Installation						
Schedule 80 PVC piping (including T-connections, elbows, valves, flanges, and reducers)	2,000	LF	$ 24	$ 48,000	CH2M HILL Est.	
Carbon steel piping (including T-connections, elbows, valves, flanges, and reducers)	1,000	LF	$ 67	$ 67,000	Source 3	
Pipe Supports, Misc Metals	1	LS	$ 30,000	$ 30,000	CH2M HILL Est.	
Install Equipment	30	CD	$ 3,000	$ 90,000	CH2M HILL Est.	
Plumbing, Fire Suppression	1	LS	$ 40,000	$ 40,000	CH2M HILL Est.	
Lighting, Misc Electrical	1	LS	$ 25,000	$ 25,000	CH2M HILL Est.	
Chemical Reagents	1	LS	$ 20,000	$ 20,000	Source 3	
550 Gallon double walled tanks for chemical storage	5	EA	$ 8,000	$ 40,000	CH2M HILL Est.	
Instrumentation and automated controls for chemical feed systems (metering pumps, tanks gauges, back pressure regulators, strainers, pressure relief valves, flow-meters, check valves, manual valves)	1	LS	$ 100,000	$ 100,000	CH2M HILL Est.	
Outfall Installation for surface water discharge	1	LS	$ 80,000	$ 80,000		
SUBTOTAL				$ 540,000		
Mobilization/Demobilization	5%			$ 27,000	Source 3	
Subcontractor General Conditions	25%			$ 135,000	Source 3	
SUBTOTAL				*$ 702,000*		
System Startup	1	LS	$ 150,000	*$ 150,000*	CH2M HILL Est.	
Compliance Monitoring and Health & Safety						
Environmental Controls	1	LS	$ 11,577	$ 11,577	Source 4	
Install Decon Shed for workers (Mobilization & Demobilization)	1	LS	$ 500	$ 500	Source 3	
Decon Shed	6	MO	$ 500	$ 3,000	Source 4	
Air Monitoring	30	DY	$ 3,000	$ 90,000	Source 4 + CH2M H&S	
PPE Provisions for Workers (Initial)	8	EA	$ 252	$ 2,015	Source 4	10 labor, 4 operator, 4 trucks, 2 supervisor
PPE Provisions for Workers (Worker-Days)	1,056	EA	$ 21	$ 22,381	Source 4 + CH2M H&S	
SUBTOTAL				$ 129,473		
Mobilization/Demobilization	5%			$ 6,474	Source 3	
Subcontractor General Conditions	25%			$ 32,368	Source 3	
SUBTOTAL				*$ 168,314*		
CAPITAL SUBTOTAL - GROUNDWATER				$ 6,782,277		
Contingency	25%			$ 1,695,569	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11	
SUBTOTAL				$ 8,477,846		
Project Management	5%			$ 423,892	**USEPA 2000, p. 5-13, >$10M**	
Remedial Design	6%			$ 508,671	**USEPA 2000, p. 5-13, >$10M**	
Construction Management	6%			$ 508,671	**USEPA 2000, p. 5-13, >$10M**	
SUBTOTAL				$ 1,441,234		
Contractor Fees						
ODC & Subs	5%		$ 8,477,846	$ 423,892		
Labor	10%	max	$ 1,441,234	$ 144,123		
SUBTOTAL				$ 568,016		
TOTAL CAPITAL COST - GROUNDWATER				**$ 10,490,000**		

OPERATIONS AND MAINTENANCE COST

SOIL

DESCRIPTION	QTY	UNIT	COST	TOTAL	NOTES	
Asphalt Repair	1	LS	$ 38,119	$ 38,119		Assumes 1% of area requires repair annually, cap costs are
Site Inspection and Repair Report	1	LS	$ 2,000	$ 2,000	Biennial Report to NJDEP	
SUBTOTAL				$ 40,119		
Contingency	25%			$ 10,030	10% Scope + 15% Bid	
SUBTOTAL				*$ 50,149*		
Project Management	5%			$ 2,507		
Technical Support	25%			$ 12,537		
TOTAL ANNUAL O&M COST				**$ 65,200**		

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Comprehensive Remediation Alternative 6: Excavation — COST ESTIMATE SUMMARY - DRAFT

GROUNDWATER

DESCRIPTION	YEAR	QTY	UNIT	COST	TOTAL	NOTES
Groundwater Treatment System O&M	**Operated During Excavation**					
GWTP Routine Operations, Maintenance, Monitoring		2,720	HR	$ 80	$ 217,600	CH2M Est. - 40 hrs/week for one operator
GWTP Chemicals / Consumables		16	MO	$ 2,000	$ 32,000	
GWTP Electricity		525,600	KWH	$ 0.10	$ 52,560	
GWTP Replace Filters/ Carbon		16	MO	$ 5,000	$ 80,000	
O&M Project Management		1	LS	$ 32,640	$ 32,640	15% of O&M Labor
Sampling and Analysis		16	MO	$ 1,200	$ 19,200	
Reporting		1	LS	$ 20,000	$ 20,000	CH2M Est.
SUBTOTAL					$ 454,000	
Allowance for Misc. Items		20%			$ 90,800	
SUBTOTAL					$ 544,800	
Contingency		25%			$ 136,200	10% Scope + 15% Bid
SUBTOTAL					$ 681,000	
Groundwater Monitoring						
Groundwater Samples		40	EA	$ 600	$ 24,000	VOC's, Arsenic, Iron
QC Samples		5	EA	$ 600	$ 3,000	
Groundwater Sampling, Level D						
Labor		300	HR	$ 80	$ 24,000	CH2M Est. - 3 persons for 5 days
Equipment - meters		1	LS	$ 2,000	$ 2,000	CH2M Est.
Consumables		1	LS	$ 3,000	$ 3,000	CH2M Est.
Data Validation		96	HR	$ 100	$ 9,600	CH2M Est.
Reporting		240	HR	$ 100	$ 24,000	CH2M Est.
SUBTOTAL					$ 89,600	
Allowance for Misc. Items		10%			$ 8,960	
SUBTOTAL					$ 98,560	
Contingency		15%			$ 14,784	10% Scope + 5% Bid
SUBTOTAL					$ 113,344	
TOTAL ANNUAL O&M COST Year 1					**$ 1,134,000**	
TOTAL ANNUAL O&M COST Year 2					**$ 454,000**	
TOTAL ANNUAL O&M COST Year 3 to 5					**$ 113,000**	

PERIODIC COST

SOIL / GROUNDWATER

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	$ 15,000	$ 15,000	CH2M HILL support to EPA Review Document Preparation
				Total	$ 15,000	
TOTAL PERIODIC COST					**$ 15,000**	

PRESENT VALUE

SOIL / GROUNDWATER

Discount Rate = 7.0%

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	PRESENT VALUE	NOTES
CAPITAL COST (Soil, Groundwater)	0	$ 848,870,000	$ 848,870,000	1.000	$ 848,870,000	
ANNUAL O&M COST (Year 1) Soil and Groundwater	1	$ 1,199,200	$ 1,199,200	0.935	$ 1,120,748	
ANNUAL O&M COST (Year 2) Soil and Groundwater	2	$ 519,200	$ 519,200	3.166	$ 1,643,589	
ANNUAL O&M COST (Year 3-5) Soil and Groundwater	3 to 5	$ 534,600	$ 178,200	0.935	$ 166,542	
PERIODIC COST	5	$ 15,000	$ 15,000	0.713	$ 10,695	
		$ 851,138,000			$ 851,811,573	

TOTAL PRESENT VALUE OF ALTERNATIVE 6 — $ 851,800,000

SOURCE INFORMATION

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).

2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)

2b. R.S. Means Company. Heavy Construction 2008. 22nd Edition.

2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.

3. Historical CH2M HILL project cost information

4. Calculations using Historical CH2M HILL project cost information (separate worksheet)

Appendix E
Constituents and ARARs for Which Waiver Is Requested

TABLE E-1
Site – Related Constituent List with Chemical-Specific ARARs
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

	Federal and State Promulgated Standards				Site-Specific Risk-Based PRGs		
Constituent	**NJ GWQS (Class IIA)[a]**	**NJ GWQS (Interim)[b]**	**State MCL[c]**	**Federal MCL[d]**	**ELCR = 10^{-6}**	**ELCR = 10^{-4}**	**HQ = 1**
Inorganics							
Aluminum	200	NA	NA	NA	NA	NA	NA
Ammonia	3,000	NA	NA	NA	NA	NA	NA
Antimony	6	NA	6	6	NA	NA	5,600
Arsenic	3	NA	5	10	4,300	430,000	28,000
Beryllium	1	NA	4	4	NA	NA	NA
Cadmium	4	NA	5	5	NA	NA	2,300
Cobalt	NA	100	NA	NA	NA	NA	NA
Iron	300	NA	NA	NA	NA	NA	65,000,000
Lead	5	NA	15	15	NA	NA	NA
Mercury	2	NA	2	2	NA	NA	19,000
Nickel	100	NA	NA	NA	NA	NA	NA
Selenium	40	NA	50	50	NA	NA	NA
Sulfate	250,000	NA	NA	NA	NA	NA	NA
Thallium	2	NA	2	2	NA	NA	6,000
Zinc	2,000	NA	NA	NA	NA	NA	NA
VOCs							
1,2,4-Trichlorobenzene	9	NA	9	70	NA	NA	NA
Benzene	1	NA	1	5	810	81,000	2,700
Chloroethane	NA	5	NA	NA	NA	NA	NA
Ethylbenzene	700	NA	700	700	NA	NA	NA

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Constituent	**NJ GWQS (Class IIA)[a]**	**NJ GWQS (Interim)[b]**	**State MCL[c]**	**Federal MCL[d]**	**ELCR = 10^{-6}**	**ELCR = 10^{-4}**	**HQ = 1**
Styrene	100	NA	100	100	NA	NA	NA
Toluene	600	NA	1,000	1,000	NA	NA	NA
Xylenes, m/p-	1,000	NA	1,000	1,000	NA	NA	NA
Xylenes, Total	1,000	NA	1,000	1,000	NA	NA	10,000
PAHs							
2-Methylnaphthalene	NA	30	NA	NA	NA	NA	4,300
Acenaphthene	400	NA	NA	NA	NA	NA	NA
Acenaphthylene	NA	100	NA	NA	NA	NA	NA
Benzo(a)anthracene	0.1	NA	NA	NA	9.5	950	NA
Benzo(a)pyrene	0.1	NA	0.2	0.2	0.56	56	NA
Benzo(b)fluoranthene	0.2	NA	NA	NA	5.5	550	NA
Benzo(g,h,i)perylene	NA	100	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	0.5	NA	NA	NA	59	5,900	NA
Chrysene	5	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	0.3	NA	NA	NA	0.36	36	NA
Fluoranthene	300	NA	NA	NA	NA	NA	NA
Fluorene	300	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.2	NA	NA	NA	5.3	530	NA
Naphthalene	300	NA	300	NA	250	25,000	370
Phenanthrene	NA	100	NA	NA	NA	NA	NA
Pyrene	200	NA	NA	NA	NA	NA	NA

TABLE E-1
Site – Related Constituent List with Chemical-Specific ARARs
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

	Federal and State Promulgated Standards				Site-Specific Risk-Based PRGs		
Constituent	**NJ GWQS (Class IIA)[a]**	**NJ GWQS (Interim)[b]**	**State MCL[c]**	**Federal MCL[d]**	**ELCR = 10^{-6}**	**ELCR = 10^{-4}**	**HQ = 1**
SVOCs							
2,4-Dimethylphenol	100	NA	NA	NA	NA	NA	NA
Biphenyl	400	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	860
Nitrobenzene	6	NA	NA	NA	NA	NA	NA
Pentachlorophenol	0.3	NA	1	1	NA	NA	NA
Phenol	2,000	NA	NA	NA	NA	NA	NA

MCL, Maximum Contaminant Level.
Note: Groundwater concentrations presented in micrograms per liter. Values in grey are not exceeded within OU1 and therefore do not need to be waived. Risk-based PRGs for COCs are presented for HQ (Hazard Quotient) = 1, ELCR = 1×10^{-4}, and ELCR = 1×10^{-6}. COCs are defined as contributing a chemical-specific ELCR > 1×10^{-6} or HI (Hazard Index) > 0.1 when receptor total ELCR > 1×10^{-4} or HI > 1.0. PRGs may be revised based on the outcome of discussions with EPA and NJDEP regarding background concentrations of COCs in the vicinity of the Site.
[a]New Jersey Groundwater Quality Standard; http://www.state.nj.us/dep/wms/bwqsa/gwqs_table1.html; accessed December 29, 2009.
[b]New Jersey Interim Groundwater Quality Criteria; http://www.state.nj.us/dep/wms/bwqsa/gwqs_interim_criteria_table.htm; accessed December 29, 2009.
[c]New Jersey State Primary and Secondary Drinking Water Standards; http://www.state.nj.us/dep/watersupply/standard.htm; accessed June 17, 2010.
[d]EPA Maximum Contaminant Levels; http://www.epa.gov/safewater/contaminants/index.html#mcls; accessed December 29, 2009. NA, not applicable or not available.
*Constituent is not Site related; refer to Table E-2.

TABLE E-2
Summary of Non-Site-Related Constituents
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Constituent	Lowest ARAR		Maximum Constituent Concentration by Background Well (µg/L) MW-124		MW-125	MW-127	MW-J	MW-M	Maximum Constituent Concentration (µg/L)		Justification/Source
Manganese	50	NJ GWQS	20.6	J	156	1,560	466	149	1,560		Exceedances are distributed across all properties comprising OU1; constituent was detected in background wells. Greater concentrations were detected in black/brown fill than in reddish-purple soils (CH2M HILL, 2007). The average background well concentration (470 µg/L) is well above the NJ GWQC (50 µg/L).
Sodium	50,000	NJ GWQS	150,000		184,000	104,000	1,340,000	208,000	1,340,000		Present throughout the area including in all in background wells . This constituent's presence in groundwater is most likely related to the former estuarine setting at the Site and/or as a result of the Site's proximity to the saline water of the Hudson River. The average of background concentrations (397,200 µg/L) is greater than the applicable GWQC (50,000 µg/L).
1,1-Dichloroethane	50	NJ GWQS	0.35	J	—	—	—	—	0.35	J	Detected above the applicable criterion at one location (MW-B) on the former Celotex property.
1,2-Dichloroethane	2	NJ GWQS	—		—	—	—	—	—		This constituent was detected once above the applicable criterion in MW-B on the former Celotex property. The depth of the well screen is approximately at the level of the former ground surface; however, the constituent was never detected in a soil sample at OU1.
Tetrachloroethene	1	NJ GWQS/ NJ MCL	2.1		—	—	—	—	2.1		Constituent has not been detected above applicable criteria on the Quanta property; however, concentrations above the criteria have been detected in upgradient and cross-gradient monitoring wells.
Trichloroethene	1	NJ GWQS	103		—	—	—	—	103		Constituent has been primarily detected above applicable criteria in upgradient or cross-gradient monitoring wells. Exceedances on the Quanta property are limited to the deep sand unit.
Vinyl Chloride	1	NJ GWQS	—		—	—	—	—	—		Two shallow exceedances on Lustrelon, one shallow exceedance on Edgewater, and one deep exceedance at MW-101DS (not site related per RI Report Section 4.4.3).
bis(2-Ethylhexyl) phthalate	3	NJ GWQS	—		—	4.1	—	—	4.1		Although this constituent was detected at a low concentration in one NAPL sample, it is also present at low levels in soil throughout all properties investigated and in Hudson River sediment. BEHP has not been detected in groundwater on the Quanta property.
4,4'-DDD	<u>0.1</u>	NJ GWQS	—		—	—	—	—	—		Constituent detected slightly over the NJGWQS in one monitoring well on the Quanta property. Sporadically detected in other wells within OU1 at concentrations less than the NJ GWQS. No point source has been identified; these detections represent noncontiguous residual concentrations likely due to past historical application of pesticides.
4,4'-DDE	<u>0.1</u>	NJ GWQS	—		—	—	—	—	—		Constituent detected slightly over the NJGWQS in one monitoring well on the Quanta property (J-flagged). Sporadically detected in other wells within OU1 at concentrations less than the NJ GWQS. No point source has been identified; these detections represent noncontiguous residual concentrations likely due to past historical application of pesticides.
alpha-BHC	<u>0.02</u>	NJ GWQS	—		—	—	—	—	—		Two J-flagged exceedances on Quanta (MW-112B and MW-117B). No point source has been identified; these detections represent noncontiguous residual concentrations likely due to past historical application of pesticides.
Chloride	250,000	NJ GWQS	397,000		413,000	208,000	5,650,000	267,000	5,650,000		Chloride is present throughout the area including in all in background wells. This constituent's presence in groundwater is most likely related to the former estuarine setting at the Site and/or as a result of the Site's proximity to the saline water of the Hudson River. The average background concentration (1,387,000 µg/L) is greater than the applicable GWQS (250,000 µg/L).

NJ GWQS, New Jersey Groundwater Quality Standard. Available from http://www.state.nj.us/dep/wms/bwqsa/gwqs_table1.html; accessed December 29, 2009.

NJ MCL, New Jersey Maximum Contaminant Level. Available from http://www.state.nj.us/dep/watersupply/standard.htm; accessed June 17, 2010.